We Built This Town

Raising Activity Awareness through the Workplace Using Gamification

by

Shawn Nikkila

A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Science

Approved November 2013 by the
Graduate Supervisory Committee:

Hari Sundaram, Chair
Daragh Byrne
Hasan Davulcu
Loren Olson

ARIZONA STATE UNIVERSITY

December 2013

ABSTRACT

The wide adoption and continued advancement of information and communications technologies (ICT) have made it easier than ever for individuals and groups to stay connected over long distances. These advances have greatly contributed in dramatically changing the dynamics of the modern day workplace to the point where it is now commonplace to see large, distributed multidisciplinary teams working together on a daily basis. However, in this environment, motivating, understanding, and valuing the diverse contributions of individual workers in collaborative enterprises becomes challenging. To address these issues, this thesis presents the goals, design, and implementation of Taskville, a distributed workplace game played by teams on large, public displays. Taskville uses a city building metaphor to represent the completion of individual and group tasks within an organization. Promising results from two usability studies and two longitudinal studies at a multidisciplinary school demonstrate that Taskville supports personal reflection and improves team awareness through an engaging workplace activity.

To my mother and father who always pushed me forward and showed me why this world

is wonderful.

To my sis with whom I have shared many fun adventures with.

To my long-time friends who I can always rely on.

and

To my past and present homies in AME who turned the fun up to 11 throughout my

graduate career.

ACKNOWLEDGMENTS

Wow, it's amazing how much time flies, and even now, it's hard to believe that I'm finally flying from the roost and moving on to other ventures in my life. All of this wouldn't have been possible without the support of my family. I would like to thank my parents for supporting me throughout my graduate career and providing encouragement to me during my highs and during my lows of which there were plenty of each. I would also like to thank my sister, Jana, for bearing with me whenever I needed an ear to vent to. I'd also like to thank her for not only being a good sister, but also for being a good friend. Finally, I'd like to acknowledge the smallest member of my family: Kenshin, the cat, who never failed to brighten up my day.

I would also like to acknowledge some of my friends who helped keep me sane throughout my graduate career. I'd like to thank my longtime friend, Nathan Marine, for commiserating with me throughout our entire undergraduate and graduate careers at ASU. I'd also like to thank Silvan Linn and Ryan Spicer, two former lab mates who, over time, grew to be two dependable and close friends. Jamming with them on research and other things was always a good time, and I learned a great deal from those two. Without them, it just wouldn't have been the same. I would also like to give a shout out to my fellow past and present AME homies who were always a blast to hang out with and talk to. In no particular order, I'd like to thank Nicole Lehrer, Mike Baran, Nicole Williams, Omid Alipourfard, Gye Won Gho, Kim Swisher, Diana Siwiak, Chris Miller, and Boyd Branch. I apologize in advance if I forgot a name or two in there, but you're all awesome regardless and will be sorely missed.

TABLE OF CONTENTS

LIST OF FIGURES

Figure	Page

x

CHAPTER 1

INTRODUCTION

The development of information and communications technologies (ICTs) has seen a renaissance in the late 20th and 21st century thanks to the wide adoption and proliferation of the Internet. The 2011 United States Census reports that approximately 75.6% of US households have a computer (US Census Bureau, 2013) and also reports that approximately 71.7% of households have access to the Internet which has continued to increase year over year. Additionally, smartphones were reported as being used by about 48% of the nation's populace with usage being primarily centered on young, highly educated professionals. The increasing connectivity and technological sophistication of these individuals have led to the development of a multitude of technologies that keep individuals connected across large distances. These include social networking platforms like Facebook and Twitter; video conferencing platforms like Skype and Google Hangout; live streaming video services like Twitch; and too many more examples to list here.

In parallel to these developments, many large companies continue to diversify their products and services in order to stay competitive and to meet the demands of an increasingly globalized market. In today's modern workplace, one is likely to encounter a large number of globally distributed, multidisciplinary, and diverse collaborative teams working on variety of complex projects (Mitchell, Inouye, & Blumenthal, 2003). It is not uncommon to see teams within a large corporation to work with other teams from around the world. Additionally, the rapid advancement and adoption of ICTs alluded to earlier have resulted in a large shift in the dynamics of workplace activity. The traditional view

of the workplace in Western culture has been the 9-to-5 job where an employee was expected to physically be present at the workplace during a set period of time. This is rapidly becoming phased out due to ICTs, such as smartphones, video conferencing software/hardware, cloud servers, etc. which has allowed an increasingly tech-savvy workforce to adopt flexible working schedules (Hardill & Green, 2003). These technologies enable these individuals to not be constrained by the physical and temporal boundaries of the workplace, but instead, have allowed them to work anywhere at any time. Walk into any urban coffee shop and you are likely to see several young professionals working diligently on their laptops. With youth being the primary adopters of such technology, this trend of working outside the boundaries of the workplace will only continue.

These changes can be beneficial for today's modern worker. ICTs allow individuals to stay in contact over large distances reducing the cost overhead associated with traveling, the frequency of interruptions; number of unproductive meetings (Nardi & Whittaker, 2002); and issues of availability (Kraut, Fussell, Brennan, & Siegel, 2002). However, at the same time, these factors result in a work environment that has become increasingly decentralized which can be detrimental to successful, collaborative endeavors. Prior research has made a compelling case showing that collocated work has many benefits that cannot be reproduced through distributed workplace activity. For instance, Nardi and Whitaker examined the role of face-to-face communication in managing collaborative relationships (Nardi & Whittaker, 2002). Their findings show that there are numerous benefits in using this type of communication that cannot be replicated using technological means. For instance, the act of sharing social and

2

emotional experiences in a common, physical workplace was identified as important for creating new and fostering old relationships (Nardi & Whittaker, 2002). They also identified the importance of body language and physical, social activities, such as going to lunch with co-workers in maintaining a healthy work environment.

Other problems stemming from distributed work can include feelings of isolation, increased conflict, and decreased cooperation (Hinds & Bailey, 2003). While all of the issues discussed above can be addressed by company-wide policies and initiatives, there is also an opportunity to address them through the use of carefully designed interactive systems. Particularly, these systems can address the following challenges that face distributed teams in the workplace: 1) individuals may not be aware of the activities that are occurring within their own team and at different organizational levels; 2) individuals may not receive enough feedback on how their work is contributing to the progress of the project as a whole; and 3) individuals who work on routine tasks may find them disengaging and dull thus reducing the motivation to complete them. Based on these three challenges, the following questions can be asked:

How and what are we doing?

Over time, an individual's workplace contribution can become routinized to the extent that completed tasks may become effectively invisible in their daily experience (Boehner, Gay, Sengers, Brooke, & Chen, 2004). While bad enough in normal circumstances, this problem becomes even more apparent within the context of distributed workgroups. Maintaining awareness of the workplace is an important prerequisite for successful and meaningful coordination between different parties (Dourish & Bellotti, 1992; Gutwin & Greenberg, 1996), but it can be an extremely

3

challenging task on its own (Brush, Meyers, Scott, & Venolia, 2009). Numerous support systems have been constructed and studied with the goal of improving intra-group communication with co-located digital information systems proving particularly effective (Brush et al., 2009; Terrell & McCrickard, 2006; Wilson, Galliers, & Fone, 2006).

What is my contribution?

It is easy for an individual who is working alone to identify the work that they have done for a project and the role that it played in the success or failure of it. However, in today's increasingly decentralized workplace, it can become difficult for an employee to assess their individual impact on the project. Feedback, in the form of either acknowledgment of work completed or constructive criticism of work attempted, is valuable in any environment, as it gives an individual the motivation to continue on with the tasks at hand (Geister, Konradt, & Hertel, 2006). However, small, individual routine tasks may not warrant direct feedback from supervisors or coworkers, curtailing enthusiasm and dampening the motivation for task completion. Similarly, individuals may be assigned small tasks that are incorporated into larger, long-term projects where feedback or acknowledgement is not received until it is completed. In such cases, regular individual critique can be a valuable tool to keep individuals motivated.

Are we having fun yet?

Fun and recreation can be a beneficial aspect of the workplace. Non-disruptive recreational workplace activities can boost morale, enhance creativity, and result in a more pleasant work environment (Oravec, 2002). These activities can include the use of games although this is commonly met with skepticism due to their association as an entertainment medium that is unsuitable for a workplace environment (Pearce, 2006).

4

However, if designed and implemented carefully, the incorporation of gameplay mechanics and elements into a non-disruptive workplace intervention can be beneficial in many ways.

1.1 Research Methodology and Contributions

To effectively address these questions, this thesis presents the design, development, and evaluation of Taskville which is a novel, interactive game for the workplace that aims to raise awareness of workplace activity. Taskville uses a city building metaphor where teams within a larger organization expand their cities with buildings by completing tasks. This is accomplished by having individuals submit task information to the system. Taskville answers the questions presented above in the following manner.

1.1.1 How and what are we doing? Taskville addresses this question by providing a unique visual interface that presents workplace tasks as buildings. These buildings are clustered into neighborhoods based on which users they belong to. By doing so, individuals who view the system can easily see, at a glance, the contributions that an individual has made in a group. Additionally, individuals can get an overall view of the specific work a group is engaged in by examining tag clouds that float across the region. The inclusion of buildings that correspond to collaborative tasks as well as situating Taskville in semi-public areas are ways in which Taskville seeks to foster community building and encourage collaboration within the workplace. Alerts in the game, through the use of Twitter and messages on the web site, inform others of what activity is occurring in the game and thus the workplace.

1.1.2 What is my contribution? Similar to the previous question, Taskville addresses this through the use of its visual interface. Users can easily see their contributions to the workplace by examining the neighborhoods of buildings that they have built in their city. Additionally, users can receive feedback on the work that they do by receiving achievements in Taskville based on the contributions that they have made to the workplace.

1.1.3 Are we having fun yet? Taskville draws inspiration from gamification research which seeks to integrate game mechanics and game design theory into traditionally non-gaming contexts such as the workplace. Additionally, Taskville is influenced by successful game design principles found in more traditional games. Taskville's design synthesizes and builds upon these two areas of inquiry. The goal of including these elements into Taskville is to increase user engagement by making the system fun to use in the workplace and to break the monotony of routine tasks which are significantly less fun. This is accomplished by including competitive mechanics as well as incorporating achievements which can be unlocked by players.

1.1.4 Methodology. Taskville is the result of following a specific methodology over the course of several years. This methodology consisted of the following steps with each having a unique contribution to this research:

1. The creation of heuristics based on prior work to aid in the development of workplace games which seek to raise activity awareness. Eight heuristics were developed that provide a good balance between user engagement and fun while not being overly disruptive to the day-to-day activities that occur in the workplace.

2. The development of a system which followed these heuristics (Taskville).

3. Two initial pilot studies which validated using a workplace game to raise awareness in the workplace (Nikkila, Linn, Sundaram, & Kelliher, 2011).

4. An iterative design process where Taskville was improved upon based on feedback from the pilot studies.

5. Two longitudinal studies which further examined the effectiveness of Taskville as an awareness tool (Nikkila, Byrne, Sundaram, Kelliher, & Linn, 2013).

The purpose of the pilot and longitudinal studies was to answer the three questions posited earlier by examining the utility of the heuristics, the effectiveness of Taskville as an awareness tool, and the effectiveness of Taskville in promoting coordination and community building. A final contribution of this research is the examination of longitudinal evaluation tools for systems like Taskville. To address this, Studious was developed which is a Ruby on Rails plugin/gem which aids researchers in conducted repeated measures studies, specifically those that follow, or are related to, the experience sampling method.

1.2 Document Structure

The remainder of this thesis will be structured as follows. Chapter 2 will examine prior research as it relates to Taskville. Particularly, prior research conducted in the areas of coordination and awareness, visualization tools, and serious games/gamification will be presented in detail. Chapter 3 provides a detailed examination of the design and development of Taskville. Specifically, it goes over the heuristics that were created for use in the development of workplace games. The chapter then examines the design and

implementation of Taskville using these heuristics. Finally, the chapter concludes with a more technical examination of Taskville by discussing the underlying system architecture.

Chapter 4 covers the pilot studies and longitudinal studies. The changes that were made to Taskville between these studies will also be discussed in this chapter. Chapter 4 concludes with a summary of results from the studies and a discussion on how successful Taskville was in addressing the three questions presented previously.

Chapter 5 examines how Taskville can be evaluated in longitudinal studies that also examine productivity and morale. This chapter goes over the design and implementation of a system for collecting experience sampling data which is a useful technique for measuring day-to-day experiences and how they change over time. Such a system could be extremely beneficial for validating the efficacy of workplace-situated systems such as Taskville.

Chapter 6 goes over future work that will benefit Taskville based on the feedback from the longitudinal studies. Finally, the last chapter will offer concluding remarks and a summary of the contributions made in this thesis.

CHAPTER 2

PRIOR RESEARCH

There is a rich history of research that examines the various questions posited in Chapter 1 that Taskville addresses. Primarily, this chapter focuses on two areas which are of importance to Taskville. The first area involves research on gamification which is the incorporation of game mechanics and game design principles into non-gaming contexts. Additionally, Taskville is a system which is ideally shown on semi-public displays that aims to effectively visualize workplace contributions. Therefore, the second area of research that will be examined is visualization and activity awareness tools.

2.1 Serious Games and Gamification

In the past, games have been explored as a way to increase the enjoyment of mundane, mandatory workplace tasks. These games have most notably been used for human resource tasks such as mandatory employee training (Curtin, Carpenter, & Ritzo, 2006) or as a team building tool within Second Life (Ellis, Luther, Bessiere, & Kellogg, 2008) (see *Figure 1*).

These types of games are part of a broader trend known as gamification which is a relatively recent research area that has garnered significant interest from human-computer interaction (HCI) practitioners in recent years. Gamification explores how game mechanics and best principles from game design can be transplanted into contexts which are traditionally outside the realm of games (Deterding, Dixon, Khaled, & Nacke, 2011). The fundamental idea behind this is simple: games are fun and engaging to an increasingly broadening audience, so why not take elements from successful mainstream games and apply them elsewhere in order to increase long term user engagement?
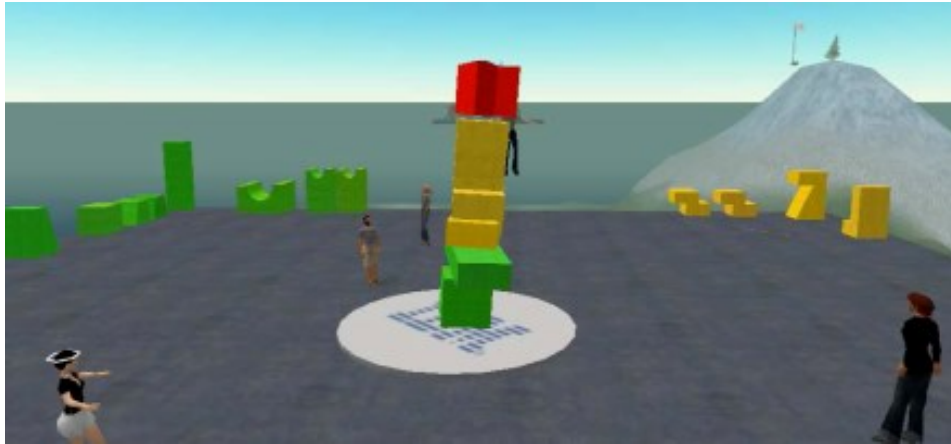
Figure 1. An example of a game created in Second Life that is used for team building exercises. In this example, workers have to work together to stack blocks in order to create a tall structure (Ellis, Luther, Bessiere, & Kellogg, 2008).

Contexts in which gamification principles can be applied to are nearly limitless and can include human resource tasks as noted previously, increasing a child's likelihood to comply with prescribed medical regimens (Bartholomew et al., 2000; Lieberman, 2001; Nikkila, Patel, Sundaram, Kelliher, & Sabharwal, 2012; Papastergiou, 2009), and other workplace scenarios which are of particular interest for Taskville.

One example of gamification principles being applied to a workplace task is PSDoom which transplants system administration tasks into the classic videogame, *Doom* (Chao, 2001). Specifically, in PSDoom, system processes are represented as monsters from *Doom* with the process ID and name overlaid on them. In order to lower the priority of the process, the user simply shoots the process with a weapon. With enough "hits" from the weapon, the monster dies and the corresponding process is killed. While seemingly silly at first glance, the use of an existing videogame in a non-gaming context reveals an interesting perspective on a routine, mundane task. In PSDoom, users have limited ammunition to use and monsters can attack each other. This dynamic encourages the user to better understand the relationships between processes and to strategically

evaluate which processes should be killed adding a new layer of reflection on a seemingly trivial task. This approach has merit and is relatable to a large swath of people as evidenced by the significant response PSDoom received when it was released. Taskville builds upon this work by similarly providing a unique, game interface for users to interact with while avoiding a significant problem present in PSDoom. The problem is that the subsystem for managing processes has to be integrated and *worked around* the game, *Doom*. This results in the interface being obtuse and uninviting for a non-gaming audience. Taskville avoids this issue by having its design (visuals, user interface, etc.) specifically focused on raising awareness.

Gamification has also been used to aid workers who are required to watch surveillance footage for an extended period of time. Shastri et al. overlaid a simple, object catching game into surveillance footage (Shastri, Fujiki, Buffington, Tsiamyrtzis, & Pavlidis, 2010). Their findings show that individuals were more attentive to what was occurring in the footage when this game was present. What is interesting about their work is that games are typically perceived as only having entertainment value and thus having no value in the workplace. However, in this scenario, a game was found to actually *increase* the performance of the worker which is contrary to this popularly held opinion. Taskville seeks to similarly show that a game situated in a workplace environment can be beneficial as well but examines it in a far different context. Shastri et al.'s work focuses on one particular context, surveillance workers, and is geared primarily towards the individual. Within this work, we innovate over the contribution of Shastri et al, similarly exploring the role of workplaces games as complimentary to rather than competing with productivity but extending the scope of their work significantly to provide general tools

which can be co-opted for use within diverse workplace activity and cooperative scenarios.

2.2 Visualization and Activity Awareness Tools

Visualization techniques and tools have a long, storied history with regards to HCI and design research. Of relevance to Taskville is research done on co-located displays and interactions as well as research examining information visualization approaches that effectively convey a large amount of information to the user.

2.2.1 Co-located displays. There have been multiple instances of co-located displays being used in workplace environments. One such system, developed by Terrell and McCrickard, used a public display to keep track of who was present in the office at any given time (Terrell & McCrickard, 2006). Their findings showed that their system was successful in facilitating communication and deeper interactions between individuals. Similarly, large scale displays and systems have also been examined for use in hospital spaces. The system developed by Bardram et al. provides a large screen, interactive display that keeps hospital staff up to date on the activities and whereabouts of doctors and other essential staff (Bardram & Hansen, 2010). Other work has examined the use of semi-public, shared displays in supporting collaborative work in small groups and finding that the extra layer of information is useful (Wilson et al., 2006).

Other research has examined the affordances of large, public displays for gaming. Work done by Cao et al. have shown the potential of multiplayer games developed for large public displays in encouraging playful interactions between strangers (Cao, Massimi, & Balakrishnan, 2008). They developed a game which tasked players to cooperate in solving a jigsaw puzzle, with added twists, on a large public display using

motion controllers. Finke et al. also developed a game that was meant to be played with a combination of mobile devices and large public displays (Finke, Tang, Leung, & Blackstock, 2008). While developing this game, they derived a user interaction framework to help guide the design of games for large displays which emphasizes the importance of players being able to learn and understand the game by observing the display. They also suggest that facilitating asynchronous competition in such a game can help keep players engaged. Taskville also adopts this strategy of asynchronous competition in order to keep users engaged long term.

Taskville combines these two approaches by providing awareness information on a large screen public display that also serves as a game. Taskville incorporates the lessons learned from the games presented above but is not a pure entertainment system; it also seeks to be utilitarian by raising awareness in the workplace. With regards to the workplace displays discussed above, Taskville takes a different approach by not only being fun and playful but by also representing activity over time. Many of the systems developed to raise awareness in the workplace are usually concerned about what is occurring at *that very moment* rather than presenting a history of activity. While this is important in certain contexts, Taskville wants to provide feedback of activity over time in order to create a sense of shared history.

2.2.2 Other activity awareness tools. Other research efforts have examined awareness in more specific, personal activities. One such example is in the use of an activity awareness technology to promote physical well-being. UbiFit Garden, developed by Consolvo et al., uses a metaphor of a growing garden to represent and motivate the completion of physical exercise routines (Consolvo et al., 2008). The garden is shown as

13

a screensaver on mobile phones and as the user continues to maintain physical fitness, the garden continues to grow with flowers and other artifacts being added over time. While similar to Taskville's city building metaphor for workplace tasks, Taskville builds upon the UbiFit idea by incorporating meaningful social interactions to help build a sense of community within the workplace.

Other work includes visualizing email conversations and relationships over long periods of time (Viégas, Golder, & Donath, 2006) which can have implications for workplace settings and visualizing real-time audio from meetings in order to help participants be aware of the conversational dynamics that occur (Bergstrom & Karahalios, 2007). Taskville differentiates itself from this work in two ways in that 1) Taskville is focused on a broader category of workplace tasks and 2) Taskville addresses awareness concerns at both individual and group levels.

Software development is another popular area for the examination of activity awareness tools. Biehl et al. developed a real-time visualization for developers which informs users of who is working on which files in a code repository (Biehl, Czerwinski, Smith, & Robertson, 2007). Another example of an awareness tool for software development is Augur developed by Froehlich and Dourish. Their implementation provides a detailed visualization showing recent activity on a code base and where that activity was situated at (Froehlich & Dourish, 2004).

Activity awareness tools have also been developed in order to better support distributed work. Begole et al. examined workplace rhythms for distributed groups by examining the email and computer usage of various individuals in order to examine how

such tools could aid in coordinating activities between workers (Begole, Tang, Smith, & Yankelovich, 2002).

One limitation of many of these approaches is that they focus on one particular activity in the workplace which limits its usefulness to those workers who partake in it. Taskville, on the other hand, examines overall activity in the workplace which can be transplanted to a variety of other workplace contexts.

CHAPTER 3

WELCOME TO TASKVILLE

Figure 2. A snapshot of a Taskville city. See *Figure 4* for a larger view of the game and explanation of specific components.

Taskville is specifically designed to raise awareness of workplace activity from multiple perspectives: at the level of the organization, group, and individual. The hope is that raising awareness in a manner that is fun and engaging will motivate workers and result in higher productivity in the workplace. To accomplish this, a generalized set of design heuristics were developed for workplace situated games that seek to raise social awareness. An implementation of a system using these heuristics resulted in the creation of Taskville. Therefore, this chapter describes, in detail, the process of codifying these heuristics and also describes the design and development of Taskville which is a system which successfully utilized these heuristics.

3.1 Design Heuristics and Considerations

Taskville draws inspiration from a number of prior design methodologies in order to create a fun, engaging, and visually striking system that users enjoy interacting with. Specifically, Taskville draws inspiration from game design and information visualization methodology for its user interaction. Additionally, feedback from preliminary user studies was also a consideration when further iterating the design of Taskville. However, before Taskville could even be created, a set of design goals and heuristics needed to be fleshed out in order to guide the initial design of it. Therefore, this section describes these steps in significant detail.

3.1.1 Basic design goals for interactivity. Since the first commercial videogame, Pong, was released in 1972, there has been a rich tradition in advancing game design theory for electronic games which has evolved considerably from two rectangular paddles hitting a ball across the screen. Much of this evolution has been spearheaded by the commercial games industry; however, there have also been numerous academics who have examined what elements make up an effective game design and exploring ways to transplant these elements into other, more "serious" contexts. While Taskville is not a traditional game per se, game design elements were included to increase user engagement and to make interacting with the system fun. The primary challenge and contribution of designing Taskville was determining how to include game design elements to accomplish these goals without being overly distractive to a user who is trying to do their work. Therefore, Taskville is especially informed by more casual, social games that are found on Facebook and mobile platforms that require limited, isolated bursts of activity over longer periods of time while still being engaging to the user.

BUILDING TYPES IN TASKVILLE

HOUSES
Houses are reserved for smaller tasks that do not take a significant amount of time to complete. They contribute to the city's population score.

SHOPS
Shops are tasks that take a moderate amount of time to complete: anywhere from 4 to 6 hours. These buildings contribute to both the city's population and income scores.

SKYSCRAPERS
Skyscrapers are awarded for tasks that took a significant amount of time to complete (6 or more hours). These tall behemoths contribute to the city's income score.

MULTITILE BUILDINGS
Multitile buildings are given for users who participate in a task together. The size of the building is determined by the number of collaborators that were involved.

Figure 3. A description of the different building types in Taskville.

Pinelle et al. investigated factors that can improve the usability and enjoyment of digital games and presented a set of ten heuristics to aid in the development of mainstream, commercially viable videogames (Pinelle, Wong, & Stach, 2008). These existing heuristics were used as a starting point for the creation of a new set heuristics focused on the development of awareness-centered workplace games of which Taskville was a product of. Six of the most relevant heuristics from Pinelle et al.'s study were

adapted for use in this new set of workplace game heuristics. The other four heuristics were not relevant to workplace games as they were more appropriate for traditional, mass market games. These included guidelines on AI, storytelling, and other factors which are not appropriate for a game seeking to raise awareness in the workplace. Other features commonly found in more casual games also influenced the development of these new heuristics. In the end, a set of seven heuristics were developed, divided into two umbrella categories, which are described here.

Interaction and Engagement

The following are 4 of the 7 heuristics that are related to user interaction with the system and maintaining engagement over a long period of time:

1. *Simple and ubiquitous interaction:* Due to the dynamic nature of the workplace, the game should be as accessible as possible by allowing the user to interact with it anywhere at any time.

2. *Provide responsive feedback:* It is important for any input from the user to be quickly reflected on the public game display itself in order to keep players engaged.

3. *Lightly competitive:* Competition provides an underlying objective which will motivate the user to interact with the game (Salen & Zimmerman, 2003). Having this competition in place should motivate and promote the completion of tasks.

4. *Simple Rules:* Not everybody in the workplace will be intimately familiar with games. Therefore, the game should not be overly complicated and should be easily understandable (Pinelle et al., 2008). In order to be as accessible as possible, the mechanics of the game should be transparent and obvious, with a deliberately

small number of potential interactions. As players become more familiar with the game, more gameplay mechanics can be added over time.

Social Awareness and Cohesion

One benefit found in games is that they promote learning and creativity by implicitly teaching concepts to and generating insights within players through continued interaction (Koster & Wright, 2005). Similarly, in Taskville, the goal is to make its users aware of the work activities around them; in other words, to be socially aware of the workplace. To promote this idea of social awareness, the following heuristics were created:

5. *Display the game in a semi-public area:* Placing the game in an easily viewable semi-public location (e.g., a thoroughfare or lobby) creates and maintains game awareness while promoting rich, in-person interactions and discussions about the state of Taskville (Terrell & McCrickard, 2006).

6. *Promote community-building:* The overall theme should be easily understood by observers. Additionally, it should communicate a story about the community aspects of the workplace which will help users be engaged with the system and discover the benefits of using it (Greenberg & Rounding, 2001; McCarthy, Congleton, & Harper, 2008).

7. *Visually Appealing:* It is difficult to have people interact with the system if it is not visually legible or striking (Pinelle et al., 2008). To encourage interaction, multiple levels of visual interest can be used so that the system is designed to draw people in from a distance while providing greater levels of detail upon closer examination.

CITY NAME AND GROUP
Lists the name of the city and the group/team associated with the city.

CITY COUNCIL
The top four players in the city are listed here ordered by number of points.

TAG CLOUDS
Tag clouds give a high level view of work activity in each city of the organization. The tag words are taken from the task descriptions that are submitted.

MINIMAP
The minimap shows the relative locations of each city within the larger game region.

NEIGHBORHOODS
Buildings cluster together by user whenever possible. This allows the user to easily compare their contributions with other users.

CITY SCORE COUNTERS
Each city has a population and income score which is determined by the different types of buildings that comprise the city.

Figure 4. A detailed overview of the Taskville visualization. Callout bubbles describe specific areas of interest in the visualization.

3.2 Applying the Design Heuristics

Taskville is a workplace awareness tool that was developed using the heuristics outlined previously. Specifically, it is an interactive game for the workplace which is meant to be deployed on semi-public displays that are situated in areas that receive a significant amount of foot traffic. This encourages looks from passersby while also encouraging water-cooler style conversations about work activity around it. If viewing the visualization from a public display proves to be untenable in certain situations, users can interact with Taskville through a website whenever they want on their own time. In order to raise awareness in a fun and visually striking manner, Taskville uses a city building metaphor to convey the completion of tasks by individuals at the workplace. For the purposes of Taskville, a task is loosely defined as the *smallest unit of work that provides satisfaction* to the player. This allows a user to determine what constitutes a task depending on the context in which he or she does work in.

Each group is represented as a city within a larger region that represents the top-level organization. At the beginning of a city's life, it only consists of a solitary city hall building which sits at the center of the city's designated area. Over time, buildings will populate the city, starting at the center and radiating outwards over time. These buildings represent the completion of tasks which vary based on different factors. For example, tasks which were completed through collaboration take up a larger area of space within the city whereas tasks which were completed individually take up a small amount of space. Each of these buildings is adorned with a colored flag that indicates the owner of that task. Whenever possible, buildings are clustered together based on ownership to form continuous neighborhoods that are easily identifiable at a distance. Additionally, this

clustering also allows an individual to easily get a rough estimate of the ratio of their contributions to the team with only a quick glance.

In order to understand what other teams in the organization are working on, literal tag clouds float across the sky which contain a list of the most frequently used keywords derived from submitted tasks for different cities. This allows the viewer to quickly ascertain what a team's current focus is while also preserving individual privacy. The color of the tag cloud text identifies the city that it is referring to.

Light and friendly competition is also encouraged within Taskville at the individual, group, and intergroup levels. In each city, there are four open slots that are dedicated to the mayor, deputy mayor, and two council members. The top four users of each city fill those slots which merely serve as thematic flavor while giving these individuals some bragging rights and extra motivation to submit tasks through friendly competition. The ranking of these users is done through a combination of factors which will be discussed further in a later section. Each city also has population and income score counters which, along with the sizes of the cities, provide a simple way to compare cities against each other.

Tasks can be submitted either through Twitter, email, or the Taskville website. Shortly after submitting a task, a building parachutes down into the city. The type of building that appears depends on two factors: 1) the duration of time, in hours, spent on the task and 2) whether or not it was a task done collaboratively. There are several different types of buildings for Taskville which are described in detail in *Figure 3*.

The design of Taskville can be divided into a number of different "components" that each addresses some aspect of the design methodology.

3.2.1 Task submission via several interfaces. Initially, Twitter was the sole interface for users to submit tasks which was done for a number of reasons. For one, Twitter is a proven and tested system that provides a public API for developers to use. Therefore, Twitter could be incorporated into Taskville as an input interface with very minimal development effort. Second, Twitter is extremely simple to use and has a number of mobile and desktop clients available. This would allow Taskville users to submit tasks even when they are outside of the office by using the Twitter client on their mobile phone. Finally, Twitter allows for messages and feedback to be broadcast to players from Taskville itself and provides an avenue for backchannel communication that would allow players to discuss the game and any activity occurring in it.

In order to leverage Twitter, a special Taskville Twitter account was created that allowed players to submit tasks to it via direct messaging. These messages are then collected by the server application and parsed to create buildings in the appropriate city in the game. The syntax of these direct messages is shown in *Figure 5* below:

"t" | "w" | "p" (task duration in hours) (@collaborator)* (*task name*)

Figure 5. The syntax of a task submission on Twitter. The first character indicates the type of task (work or personal). The remaining fields are optional. The second field lists the number of hours spent on the task. The third field lists all individuals who collaborated on the task. The last field is a description of the task.

The first element specifies the type of task being submitted which can be personal ('p') or work related ('w' or 't'). The duration, collaborators, and the task name are all optional, but a duration value must be specified if a task name is given. An example of a full task submission message following the above format would be:

24

```
         T 12 @Trigun2101 Editing and writing thesis.
```

Figure 6. An example task submission. This submission indicates that the player is submitting a workplace task that he/she collaborated on with another player named Trigun2101. The task took 12 hours to complete and the description indicates that the task was for editing and writing a thesis.

The above figure (*Figure 6*) shows an example of a task being submitted to the system. The first character is a 't' which informs the system that it is a work related task. The number, 12, indicates that the task being submitted took approximately twelve hours to complete (rounded to the nearest hour). The third part of the message lists any collaborators that participated in the task. Similar to Twitter, these collaborators are listed by username with the '@' prepended to each collaborator listed. Multiple collaborators are delineated by a space in between their names (e.g. @Trigun2101 @SuperMustacheo). The final part of the message describes the task that was completed and can be whatever the user desires. This is not revealed to any other users in the system and is there primarily for creating tag clouds.

As demonstrated, the syntax is straightforward and easy to remember giving the user a simple way to interact with the system. While Twitter was effective as an input interface, feedback from preliminary pilot studies indicated that the users desired more choices on how to enter tasks into the system. Therefore, future iterations of the system provided the ability to send tasks via email and through a website. This gave non-Twitter users further avenues in which to submit their tasks. Additionally, specifying task collaborators and being able to submit personal tasks were added in later iterations of Taskville, and the rationale for doing so will be revisited later.

This system gives users the freedom to submit any tasks that they feel are appropriate; however, this lack of constraint can result in scenarios that are less than ideal. Since tasks are dependent on the context of the work being done and are completely subjective, it is not possible for the system to automatically and reliably check the validity of every task that is submitted. For example, some workers may view meetings as a valid work-related task while others may demure from making that association. Because of this broad definition, it is very possible for the users of the system to "cheat" by sending false tasks to it or even by sending a task that is considered unacceptable by the broader user community. Therefore, an assumption has to be made that the community-based nature of the game will deter this behavior with observant participants noticing if certain tasks seem amiss in some form or another. For example, during initial testing of the system, one user considered washing the dishes as a task since he was thinking of work while doing it. Another user submitted a dream as a task since the dream was centered on being at work. While these are entertaining and may very well be tasks in the minds of these individuals based on their perception of what constitutes a task, a majority of other users took notice and had objections to these submissions. Therefore, an assumption was made that a series of "unwritten rules" (Sniderman, 1999) beyond the current, in-place constraints/rules of the system will be established among users to discourage unethical or questionable activity.

3.2.2 Immediate feedback to users. Taskville provides immediate feedback via a public display that hosts the client application. The server application continually checks the Taskville Twitter and email accounts for submitted tasks on very short, periodic intervals. When it receives new tasks, it immediately places the building into an

appropriate location and saves it to the database. In turn, the client application continually checks for updates from the server and visually updates the city with any new buildings when one is received. A popup message is also displayed on the client display which provides additional information about the task such as who built it and the building type. Therefore, an individual that is viewing the visualization can send a task to Taskville and see his or her task transform into a building and become a part of the city in only a few short minutes.

Feedback is also given to Taskville participants through various means. After receiving a task, the server application updates the status of the Taskville Twitter account by announcing the creator of the new task and any collaborators, what type of building was placed in the city, and how many buildings are currently in the city. In later versions of Taskville, these messages were also relayed through a web interface. The intention of doing this was to keep players continuously informed of the state of the game while also spurring other players to respond by submitting their own tasks.

3.2.3 Meaningful competition. Taskville borrows many interaction design elements from games including competition between players. By their nature, games contain conflict in some form (Crawford, 1982; Salen & Zimmerman, 2003), and this conflict is often manifested through some number of competitive play elements which provides meaningful motivation for the individual to continue playing the game. To capture this, the following three levels of competition were incorporated into the Taskville design.

3.2.3.1 Personal competition. Taskville is designed to facilitate internal goal-setting by the player which can be described as a form of self-competition (i.e., playing

against oneself) (Salen & Zimmerman, 2003). By doing so, the player is not actively competing with other players but is instead setting internal goals for him/herself that can be achieved within the boundaries of the game. For example, one player might set an internal goal to complete five tasks in one day while another player may set an internal goal of beating their score from last week. Meeting these internal goals do not provide any benefits to the player but is, instead, just a meta-game that motivates the individual to continue playing the game.

3.2.3.2 Group competition. A second level of competition is found between each member of an individual group. Taskville selects a four-member city administration for each participating group. The top four participants, ordered by overall number of points, respectively become the mayor, deputy mayor, and a pair of city council members, and have their avatar prominently displayed in the visualization. While having one of these titles does not affect the game in any way, it provides a fun motivator for submitting tasks while also encouraging friendly, within group competition. Originally, points were simply a one-to-one correlation to the number of buildings that the user had in the city. However, this had its problems as a user could game the system by submitting a high number of tasks that took a short amount of time to complete. Therefore, the points system was revised to address this problem. In the current version of Taskville, points are based on the time allocated to a task rather than the number of tasks. Points gained from unlocking achievements also contribute to the user's total score.

3.2.3.3 Intergroup competition. Another prominent form of rivalry within Taskville is intergroup competition where participating groups of users work together to create the largest city. To provide a gauge of how well a city is performing, a small status
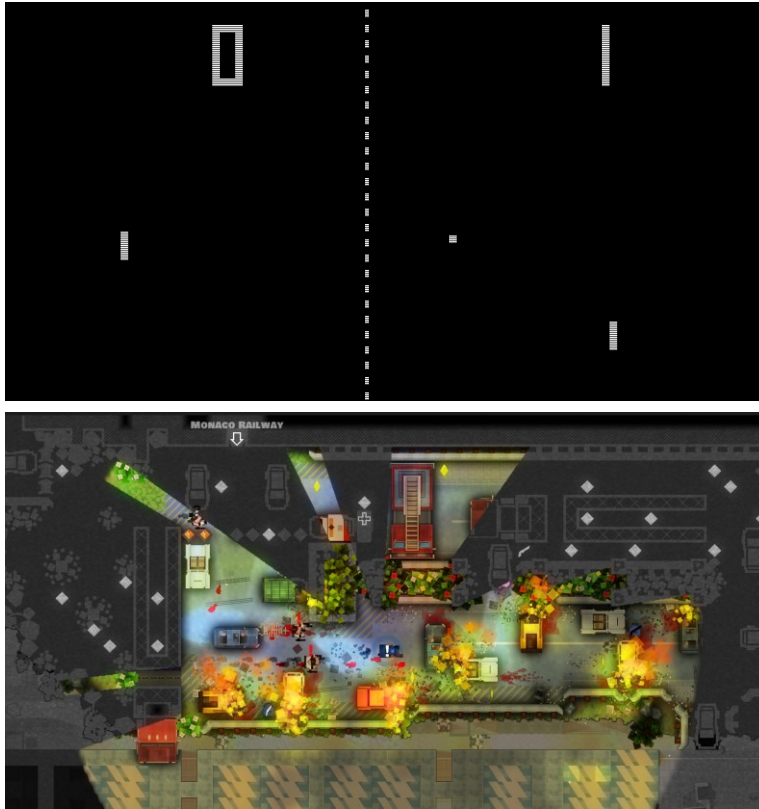
Figure 7. Example of low resolution games. Top: Pong, the first commercial videogame used abstract graphics to represent a game of tennis (Image from Wikipedia). Bottom: Monaco, a modern game utilizing modern graphics techniques but still using a low resolution, abstract design aesthetic (Image from http://www.monacoismine.com).

bar at the bottom of the display reports the city's total number of buildings, "population," and "income." Population is primarily increased by houses, and income is primarily increased by offices and skyscrapers. These values, along with the minimap, simply serve as high score counters that provide an easy way to compare cities. Finally, the Taskville Twitter account sends a tweet whenever a building is placed in a city and a message is displayed in the web interface alerting all game participants of current activity and encouraging a competitive response.

3.2.4 Community building. Taskville incorporates a city-building metaphor, lending itself well to the goal of creating an application that promotes community

29

building. A player submits buildings to their city and owns an identifiable number of buildings that are usually clustered together. However, these different individual clusters of buildings are adjacent to one another, and hence represent the city and the group.

As there can be several groups participating with their own cities within the game region, community building occurs outside of the immediate work area. In this way, the city building metaphor of Taskville acts as a lens where an individual can gain insights into the activities and achievements of another group within the same organization.

3.2.5 Aesthetics. An important requirement when designing a game, or visualization, is to have an interesting and pleasing visual aesthetic. To accomplish this, Taskville takes visual cues from classic 2D city building games such as SimCity 2000 and Caesar. Taskville's visuals uses a visual aesthetic commonly known as pixel art which is the use of low resolution graphics with a relatively small color palette (Goldberg & Flegal, 1982) (see *Figure 7*). The visuals for Taskville were created by Silvan Linn, a former MSD student at Arizona State University. The advantage of pixel art is that the lower resolution allows for art assets to be made relatively quickly while also still allowing for a significant amount of detail to be shown. Pixel art is also still a well-recognized and appreciated art form due to it being used by games for multiple decades until games transitioned to 3D models and high resolution textures. Taskville includes a number of other aesthetic elements that help keep users engaged with it. Buildings come in various sizes and color variations which add additional flavor to the visual landscape. Clouds also move across the game region thus providing a sense of motion and time passing.

3.3 Technical Specifications

From a technical standpoint, Taskville was developed using a simple, traditional RESTful (**RE**presentational **S**tate **T**ransfer) client/server model. Within this framework, the client is responsible for displaying the visualization either through an installed Adobe AIR application or by displaying a website which contains an embedded Flash application that displays the Taskville visualization. The following sections describe, in detail, how the client and server applications have been designed and implemented.

3.3.1 Server side specification and design. The Taskville server is a Ruby on Rails web application that is responsible for two primary functions: 1) to provide the state of a game region when requested by a client and 2) to update each game region when certain events occur. This functionality will be revisited in detail after describing the software architecture of the server application. The server application consists of several components that each performs a different function. *Figure 8* shows a rough schematic of the system architecture for Taskville.

3.3.1.1 Processing task submssions. To reiterate, new tasks are submitted either through Taskville's web interface, email, or Twitter direct messaging through a simple syntax that the server can understand (refer to Chapter 3.1.2.1 for additional details about this syntax). When a task is submitted through Twitter or an email client, it is the job of the update daemon to retrieve this data. The update daemon accomplishes this by simply continuously checking the Taskville Twitter and email accounts every 60 seconds or on whatever periodic interval the administrator desires. Regardless of how the task message is retrieved, the sender of the message is identified by examining the sender's email address, in the case of email, or by matching the Twitter user name with an existing user
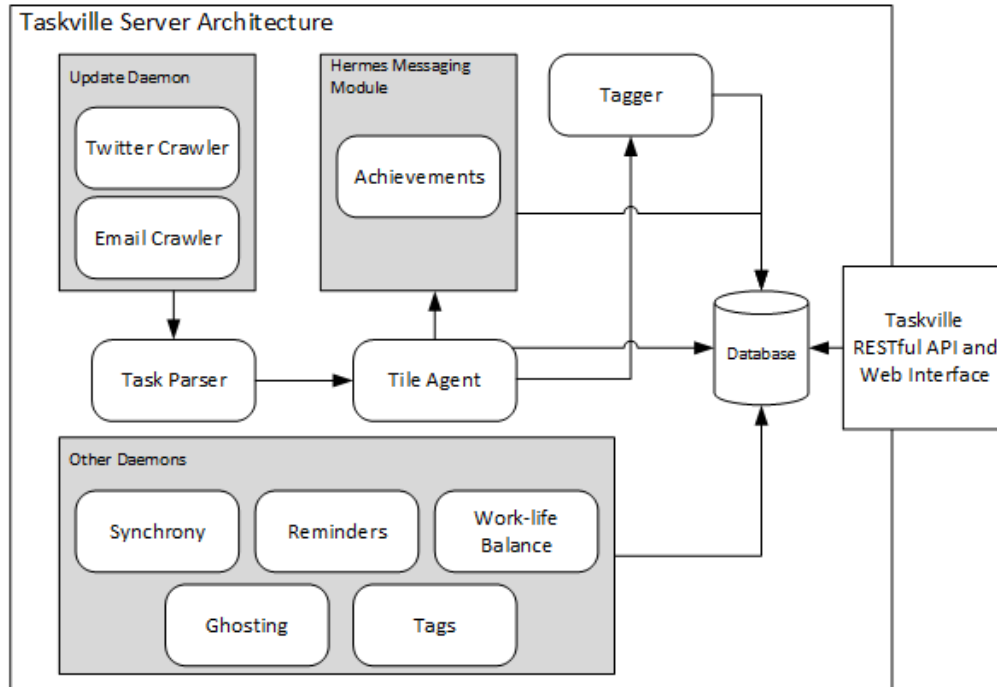
Figure 8. A diagram showing Taskville's server architecture.

name in Taskville, in the case of Twitter. If a user submits through the web interface, then it is already known who the user is since users must be logged in to submit tasks.

After the data has been retrieved by the update daemon, it is passed to the task parser which is responsible for taking the message content and parsing out the constituent parts that make up a complete task. These parts include the task type (work or personal), the duration of time in hours spent on the task, and the task description. If this data is successfully retrieved, it is passed on to the tile agent for building "construction" and placement in the game world.

3.3.1.2 Tile agent. The tile agent is responsible for "constructing" a building and finding a suitable tile location in the game region to place it. As described earlier, the tile agent determines the type of building by examining the duration of the task and whether or not it was collaborative or not. Next, for non-collaborative buildings, the server

32

determines where to place the building in the city so that it fulfills two conditions: 1) that the building is clustered, if possible, with other buildings from the same user and 2) that the building does not overlap any of the other buildings in the city. To fulfill these conditions, the server application searches for every empty tile that is adjacent to a building belonging to the user and chooses a random one of these tiles to place the building at. If one cannot be found in this manner, then any empty tile adjacent to the city is used. For multi-tile buildings, the first condition is ignored for simplicity's sake, but the algorithm for placing the building remains fundamentally the same. After this has finished, the "building" (task and placement information) is saved into the database. From this point, the tile agent checks to see if any achievements were unlocked by the user by making a series of calls to the achievement module.

3.3.1.3 Hermes achievement module. The tile agent also makes calls to an achievement module that checks to see if any achievements were unlocked by the user after submitting a task. Achievements are defined in an XML file by the developer which defines the name of the achievement, the number of points given for unlocking the achievement, a description of the achievement, and a unique ID. Each of these XML files corresponds to a plugin which is also written by the developer that determines if certain achievements have been unlocked. Each method in the plugin is named so that it matches one of the achievement IDs in the XML file. The method's logic determines if the achievement's conditions are met and returns true if so and false otherwise. If the achievement has been met, then it is associated with the user in the database. The design of this module allows any number of achievements of varying complexity to be added and is, therefore, highly extensible.

33

3.3.1.4 Tagger. The tile agent also passes the task over to the tagger module which is responsible for parsing all non-stop words and creating tags from them which are stored in the database. These tags are used for the construction of the literal "tag clouds" in the visualization which give a high level overview of the tasks that each group has been working on.

3.3.1.5 Work-life balance. This module is responsible for calculating the work-life balance of every player within Taskville. More details about how the work-life balance mechanic works can be found in Chapter 3.3.3. The work-life balance is recalculated periodically through the use of a daemon.

3.3.1.6 Ghosting. This module calculates the "ghosting" values for the buildings of every player. As described in Chapter 3.3.2, buildings which are transparent represent a user not being active, or present, in the system for extended durations of time. Like the work-life balance, these values are recalculated periodically through the use of a daemon.

3.3.1.7 Other daemons. There are numerous other "minor" modules that run on a schedule that perform useful tasks; two of which will be briefly mentioned here. The reminder module is responsible for sending out emails to users reminding them to submit tasks if they have not done so for a long period of time. The tag daemon updates the tags periodically so that only the newest tags will be displayed in the visualization.

3.3.1.8 The Taskville RESTful API. Ruby on Rails is a very popular web application framework that utilizes the REST paradigm. Typically, when a web application is said to be RESTful, it means that the application exposes a series of URLs that can be queried by a client application (typically when the client wishes to change its state). These URLs typically represent some resource that is managed by the server, and

the URL can be viewed as an "instruction" for the server to either retrieve the resource's data, modify the resource's data, or to create new data for the resource depending on the HTTP request type and the parameters given to the URL. These exposed URLs in a web application are widely referred to as a RESTful API. Data returned from a client's request can be represented in any number of forms, but the usual representation is a document format which supports highly structured data such as JSON or XML.

Since Taskville was developed using Ruby on Rails, Taskville exposes a simple RESTful API that allows clients to query the server for data when needed in order to display the visualization. The data that is returned from the server is formatted into XML. When a Taskville client initially loads, it utilizes Taskville's RESTful API to retrieve all data on a specific region. This includes the cities, the players, the buildings, statistics, and any data associated with the region. After the client initially loads, it will periodically send update requests to the server (using the RESTful API) in order to update the state of its visualization. In order to reduce overhead, the data that is returned from these update requests only consists of data that is new or has been modified since the client last made an update request.

3.3.2 Client side specification and design. Compared to the server application, the Taskville client application is fairly simple in design. The primary function of the client application is to display the visualization and to periodically update the state of the visualization by querying the server using its RESTful API. The client application was developed using Adobe's Flex SDK and a freely available game development API called Flixel ("Flixel," n.d.). Using the Flex SDK allows Taskville to be deployed either as an

Adobe's Flash application for embedding into website or as an AIR application for use on

a standalone desktop computer.

CHAPTER 4

EVALUATION AND EVOLUTION OF TASKVILLE

After an initial version of Taskville was developed based on the heuristics described in the previous chapter, two pilot studies, with 16 and 12 participants respectively, were conducted in order to determine if such a "gamified" approach towards raising awareness was indeed viable. Specifically, the pilot studies explored if Taskville had the ability to raise awareness of workplace activity and that it was fun and engaging to use for the user. The other goal of the pilot studies was to gather feedback and critique from the participants in order to improve upon Taskville's design. The results of these pilot studies were heartening and encouraged further development and evaluation of Taskville. A number of changes were made to the system after the conclusion of the pilot studies based on feedback gathered from the study participants. After these changes were made, two more longitudinal studies were conducted to further test the efficacy of Taskville as an awareness tool. These longitudinal studies were conducted over a 3 to 4 week period with a larger number of individuals and revealed that Taskville, overall, does work as an awareness tool. Qualitative feedback from the participants also revealed that the heuristics that were created in Chapter 3 were extremely successful in creating a fun, engaging, and usable system.

This chapter will start by going over the two initial pilot studies, and the changes that were made to Taskville between them. Afterwards, additional changes that were made to Taskville after the pilot studies based on feedback will be described in detail. The longitudinal studies will then be described which will be followed by a discussion on
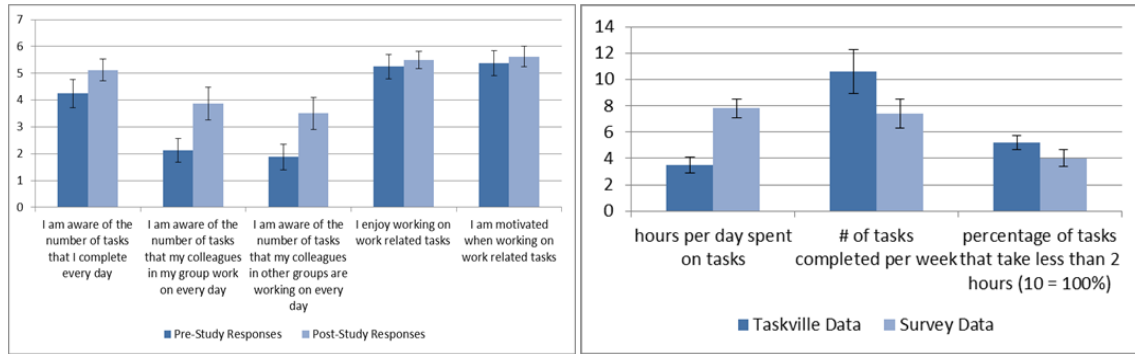
Figure 9. Responses to select questions from the study questionnaires. The top graph shows the difference between pre-study and post-study responses when asked about their work activity. There is noticeable improvement when asked about their awareness of what others are working on. The bottom graph compares responses from the pre-study questionnaires from data gathered from submitted tasks during the study. The data shows discrepancies in what the participants perceived and what was observed in the study. Bars indicate standard error.

how successful Taskville was in addressing the three questions which were presented in the introduction of this thesis.

4.1 Initial Pilot Studies

Two short pilot studies were conducted over the course of a year. These studies were designed to better understand how users interacted with Taskville and their reactions for using such a system in a workplace setting. Another goal of these studies was to assess the value of Taskville in raising awareness in the workplace. Both studies resulted in existing features being modified or new features being added based on the feedback that was received.

4.1.1 Methodology. In both studies, participants were recruited from a transdisciplinary school within a large, state university using a combination of word of mouth, flyers, and email. All participants were graduate students or faculty and were based in one of two buildings on campus (approximately 15 minutes walking distance from each other) which also served as the basis for dividing them into two different

groups. Because of the distance between these two buildings, both groups were relatively unaware of each other's activities on a short term, day-to-day basis. Therefore, these conditions provided an ideal environment to assess the usability of Taskville and to gather feedback from participants. Taskville was prominently shown on displays located in the lobbies of both spaces where the participants resided in. This ensured that Taskville would receive a significant number of views from passersby over the course of the study.

A pre-study questionnaire (see Appendix A) was administered to participants prior to the start of both studies. These questionnaires examined the participants' experiences with regards to games and productivity software. Additionally, the questionnaire asked participants to reflect on work activities such as recalling how often they complete tasks and the length of time required to complete these tasks. After participants completed these questionnaires, they were asked to use the system for some period of time. Instructions on how to interact with the system were sent out prior to this. After this period of time had elapsed, the participants were then asked to complete a short, post-study questionnaire (also see Appendix A) and to participate in one of two identical, unstructured, group interview sessions. The interviewers during these sessions had a prepared list of questions to help keep the conversation flowing, but participants were encouraged to interject and to provide their own insights and opinions throughout. These interview sessions provided valuable feedback which led to significant additions and changes to the game and its mechanics in subsequent versions of Taskville.

4.1.2 First pilot study. The first pilot study was conducted with 16 participants split between two groups. Group I consisted of 6 participants (3 male and 3 female) whereas Group II consisted of 10 participants (3 male and 7 female). The author

participated in the study with Group II along with 3 other participants who were involved with Taskville in some capacity. These 4 participants did not complete any of the surveys and did not participate in the group interview sessions. Participants were asked to interact with Taskville, at their leisure, over a period of 7 days.

At the end of this period, a total of 170 tasks were submitted to Taskville with Group I submitting 91 tasks and Group II submitting 79 tasks. The average number of tasks that were submitted each day over the course of the study was 24.29. The average number of tasks submitted per participant was 10.63.

The questionnaires were examined in order to determine if Taskville had a positive impact with regards to awareness. Eleven of the participants completed the initial pre-study questionnaire with 8 participants completing the post-study questionnaire. The results from the pre-study questionnaire were compared with data received from the game during the study. The purpose of doing so was to see if the responses given by the participants were consistent with the data recorded by Taskville from their participation in the study. Players in the study reported that they complete approximately 7.4 ± 1.1 tasks per week. However, data from Taskville shows that they actually completed approximately 10.6 ± 1.7 tasks during the one week study period which is significantly larger. Similarly, responses on the survey indicated that an average player feels that $40.1 \pm 6.3\%$ of the tasks that they do would take less than 2 hours. However, the data showed that approximately $51.9 \pm 5.5\%$ of the submitted tasks were indicated to have taken only one hour or less. These results show that there is a large discrepancy in how individuals perceive their own workplace activity versus their actual activity. Therefore, a game

based approach for raising awareness, like Taskville, could be beneficial in correcting these discrepancies.

Additionally, the responses from a series of Likert scale questions about workplace awareness and motivation found in both the pre- and post-study questionnaires were compared. The purpose of doing so was to determine if their perceptions on these matters had changed after the study had concluded. These questions were on a scale from 1 to 7 where 1 indicated that the respondent strongly disagreed with the statement and 7 indicated that the respondent strongly agreed with the statement. The leftmost graph in *Figure* 9 shows these questions and how the responses differed between the pre- and post-study questionnaires. The data shows that there was a slight improvement in how aware participants were of their own activity (5.1 ± 0.4 versus 4.3 ± 0.5). However, participants indicated that they felt more aware of what their colleagues in their group were working on (3.9 ± 0.6 versus 2.1 ± 0.4) as well as those outside of their group were working on (3.5 ± 0.3 versus 1.9 ± 0.5). Feelings of motivation for working stayed roughly the same before and after the study.

Reactions from participants who participated in the semi-structured group interview sessions were generally positive. Some participants found that Taskville succeeded in making them more aware of workplace activity.

[…] It made me a little bit more aware that, hey, there's this other part of the […] community which is who I'm talking to now relative to where I normally work that's doing stuff. I mean you know on an intellectual level that they're doing stuff, but seeing the buildings does kind of realize that wow, they're doing just as much stuff as we are. –P1

41

Another participant jokingly noted: *"It did make me more aware of how much work I was doing. It made me aware that I was doing very little." –P2*

One participant in particular was especially affected by Taskville and noted that it made her aware of how time she spends on work:

When I found that all you need to do is give you guys inputs I was like I can do this. I just happened to get into it. It was cool to see what I had been doing. The minimal input aspect of it was pretty nice and it made it easier. The time stuff too... I get angry sometimes about the amount of time I spent on work. Sometimes I think […] faculty doesn't acknowledge […] the amount of time it takes to do something. […] I like the fact that […] I built these virtual buildings to prove that my life has been doing stuff for [organization name]. –P3

In her case, she expressed frustration that there was a perceived disconnect between the amount of time she spent on her work versus how others perceived she was spending her time. Taskville provided a way for her to show that she was being productive.

One issue that was particularly concerning to participants was Taskville being used as an evaluation tool by managers. The initial version of Taskville allowed players to click on a building to view the specific task description associated with it. Participants were concerned that managers could view similar tasks done by other workers and use that as a gauge for comparison. One participant noted that Taskville *"[…] is a performance metric which makes it a little threatening […]."* Another participant stated that she went along with the study knowing that it would only last a week but would be wary in using it over a longer period of time.

I was comfortable with it because I knew it was only going to be a week. But if this was a longer thing then I probably would not have participated as much because it comes down to work ethic I guess. Maybe it takes one person 2 hours to do one task and it might take somebody else 4 hours so it's like quantifying how long it takes to do something. [...] Even if we all get the same thing done in one way ... it's like some person took more time and some person took less time to get something done. –P4

In other words, some participants viewed Taskville as threatening due to the possibility of its intended use being subverted into a tool for evaluation. Because time is featured so prominently in Taskville, there was a fear that it would be used as a quantifiable metric to compare two employees performing similar tasks without regards to other external factors that may explain the discrepancy.

Interestingly enough, participants expressed a significant amount of confusion as to what constituted a workplace task despite the guidelines given to them. One participant, P1, noted that it "*[…] wasn't really clear in the design of the system as what counted as a task.*" He eventually took an approach where he only submitted a task when it was, for the most part, completely finished. Other participants approached this from the opposite direction by logging a task whenever they switched from one task to another even if the previous task was not completed. For example, P2 stated that "*I probably have about five different major categories of projects that I'm working on. And every time throughout the day that I switch between those, I start a new task.*" He was not alone in this as P3 also took a similar approach.

Whenever I did a change, that's when I was like I'll log in this task that I did. This is probably horrible, but like, there's nothing that I feel that I complete; everything that I work on feels continuous and so slow that I took this as a temporal thing ... I viewed it as how much time am I going to allocate to this regardless of how far I get. –P3

Another subject that was brought up was Taskville's singular focus on work related activity. One participant, P2, observed that Taskville, "*Felt like we were optimizing to be one dimensional people. Work, work, work, work, work. No element in game that promotes a balanced lifestyle.*" Therefore, some participants wanted the ability to submit domestic chores, personal tasks, that were important to accomplish on a day-to-day basis but were unrelated to their work. For one participant, such a feature would provide additional motivation to perform these important tasks in a life that has become increasingly busy.

For sure; stuff like going to the gym which is like a real personal effort to make time to do something like that. Or for straight up grocery shopping. Passover and religious obligations I had no time [for] but were an obligation. I think having those aspects as a personal assistant tool; I think I would like that. I am curious how other people spend their time […]. –P3

Overall, participants indicated that they enjoyed the aesthetics of Taskville and also appreciated the simplicity of the interaction. Additionally, the competitive elements found in Taskville were found to be enjoyable by the participants. One individual expressed her enjoyment in "*trying to kick [the other group's] ass*" while another stated that the "*competition made me more honest about the time I was logging.*" These

44

responses show that a game-based approach to addressing workplace awareness concerns using the design methodology outlined earlier can be feasible in tackling this issue.

4.1.3 Changes made between studies. A number of features were added following the initial pilot study in order to address the feedback received from the interview sessions as well as to explore other dimensions important to workplace activity. These features addressed the privacy concerns as well as providing a mechanism in which collaborative activity could be expressed.

4.1.3.1 Activity summary via tag clouds. For the new version of Taskville, an *eighth dimension* to Taskville's design methodology (discussed in Chapter 3.1.1) was added: *Respect the privacy of the players*. This was added due to the privacy concerns that were expressed by participants from the first study. To address these issues in Taskville, the ability to click on a building to view a description of its associated task was removed. By obfuscating this information, individuals can no longer compare the performances of two individuals who contributed similar tasks which was the main concern brought forth by participants. Instead, to promote awareness about the content of tasks, the new version of Taskville records the frequency of all words in submitted task descriptions, allowing the system to generate literal "tag clouds" as shown in *Figure 10*. Each tag cloud contains numerous randomly arranged selections from the thirty most common words found in all the submitted tasks. The color of the text in the tag cloud corresponds to the city that it belongs to while the size of each word corresponds to how frequently the word appeared. These tag clouds provide an abstract overview of the work, allowing the viewer to reflect upon the type of work carried out in each group while still respecting the privacy of the individuals who submit the tasks.

45

Figure 10. Literal tag clouds were introduced to later versions of Taskville. Tag clouds float across the game region and give an overview of what each group is working on. The color of the text inside the tag cloud indicates the city that it is referring to.

4.1.3.2 Explicit collaboration. Collaboration is an important aspect of workplace dynamics. Therefore, in the newer version of Taskville, multi-tile buildings were introduced to show collaborative activities occurring in the workplace. The newly introduced 2x2 and 3x3 buildings show workplace tasks that were completed as an explicit collaboration by two or more players in the game. These tasks are submitted like other tasks except the list of collaborators are also specified. A 2x2 building indicates that two participants in the same group collaborated on a task together while a 3x3 building shows explicit collaboration between three or more participants. The multi-tile buildings are based off of real life structures and locations that are normally associated with social activities. The buildings presented in the game include a bowling alley, a restaurant, an outdoor shopping plaza, and a public park.

4.1.3.3 Implicit collaboration. The first pilot study revealed some interesting similarities in task submission activity between certain participants who work together frequently. Therefore, one area worth exploring was to determine if individuals in the same group frequently worked in a synchronized rhythm which Taskville refers to as *implicit collaboration*. To examine this, the new version of Taskville provided a unique

46

reward, in the form of a 4x4 Egyptian pyramid, to the group with the most implicit collaboration after a period of four days. This feature is intended to make users aware that the group is working in a rhythm. With Taskville, we define work rhythms as the similarity between users in when they submit tasks and the number of tasks that they submit.

This implicit collaboration is calculated using a combination of two metrics: the correlation between users in the distribution of tasks (number of tasks submitted per day over a period of four days) and the distance between users in terms of the density of tasks submitted. The first metric is found by simply computing the Pearson product-moment correlation coefficient between every user in the group. This measure expresses how similar two users are with regards to when they submit tasks. However, it does not take into account the total of number of tasks that were submitted by each user. To address this, the second metric, *task density*, is calculated which simply examines if two users submitted a similar number of tasks over this four day time period. This is computed by first calculating the task intensity, *I*, between two users, A and B. Task intensity is calculated by taking the total number of tasks submitted by A and dividing that by the total number of tasks submitted by B which produces a ratio as shown in Equation 1.

Using the task intensity, the *similarity* between two users can be calculated by using Equation 2. This equation ensures that $s_{a,b}$ will always be greater than or equal to 1. This can be then used in Equation 3 to compute the distance between two users.

$$I_{A,B} = \frac{\sum T_A}{\sum T_B} \tag{1}$$

$$s_{A,B} = \frac{I_{A,B} + \frac{1}{I_{A,B}}}{2} \tag{2}$$

$$d_{A,B} = 1 - s_{A,B} \tag{3}$$

Once both metrics have been computed for each user, then both users are said to be implicitly collaborating if these two metrics exceed their respective thresholds. These thresholds were manually set based on simulations that were run using synthetic data derived from the first pilot study. The group with the most users that are implicitly collaborating with each other receive the pyramid as a reward.

4.1.3.4 Additional incentives. Additionally, in order to incentivize continued participation, a new building was introduced to the game. This building is awarded to those users who submit a higher than average number of tasks relative to the other game participants over a period of two days. This building, shown below in *Figure 11*, is a single tile, golden building which serves as a testament to the player's hard work.
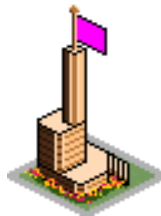

Figure 11. A golden building given to players who submit a higher than average number of tasks.

4.1.4 Second pilot study. After these changes were implemented, a second pilot study was conducted using the same methodology as the first one. Nineteen individuals were recruited to participate in this study which included two individuals who were involved with Taskville's development. However, only 12 individuals continued to participate in the study. Participation was defined as having a user submit at least one
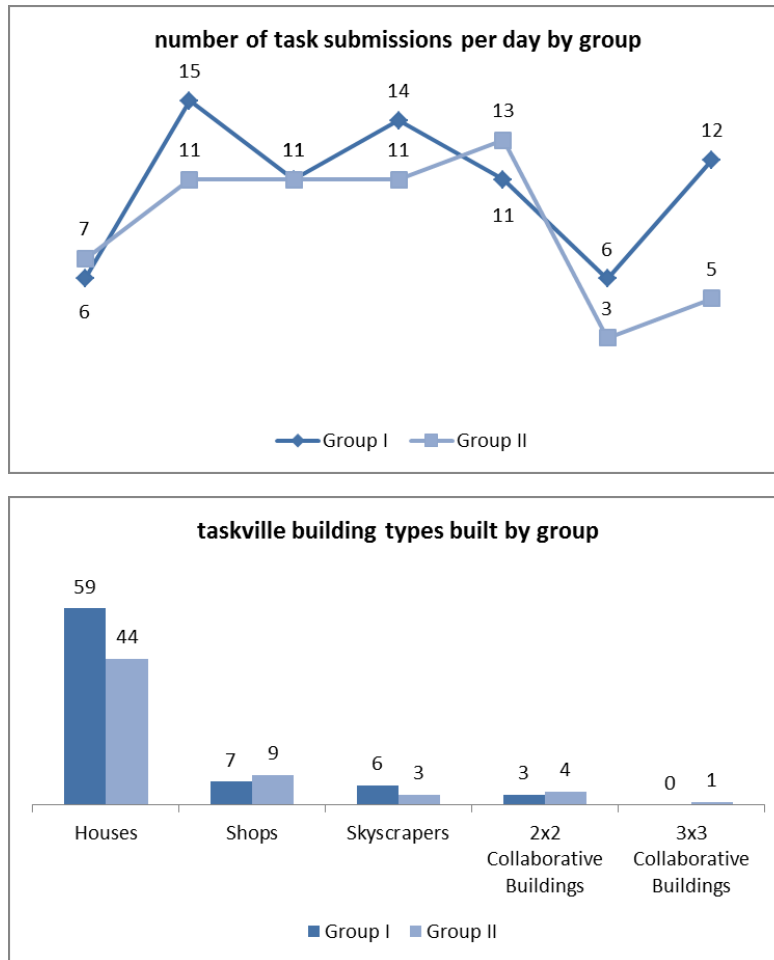
Figure 12. Two sets of data over the course of the second study showing (a) the number of submitted tasks per group, indicating that the activity of each group in Taskville is somewhat similar (r=.623, no significance), and (b) the number of houses, shops, and skyscrapers belonging to each group (r=.994, p < .001), indicating that the majority of tasks submitted by both groups were reported as being short tasks.

task to the game during the duration of the study. Ten participants were from the previous pilot study and two were new to Taskville. The study ran for a period of 8 days, but the first day was excluded due to technical difficulties.

As in the previous study, pre- and post-study questionnaires were distributed to the participants. Unfortunately, only three individuals could be included in the analysis of this data. Two participants used the same identification number which made linking the pre- and post-study questionnaires impossible for them. Another individual completed the

49

post-study questionnaire long after the study had completed. Therefore, due to the preponderance of these issues, a focus will be placed on the qualitative data received from the group interview sessions.

By the conclusion of the second pilot study, 144 tasks were submitted to Taskville. 136 of these tasks were individual tasks and 8 of them were collaborative tasks which were introduced in this version of Taskville. 78 tasks were submitted by Group I whereas Group II submitted a total of 66 tasks. The mean number of tasks submitted per day was 19.43 while the mean number of tasks submitted over all active participants was 11.33, which is comparable to the first pilot study. *Figure 12* shows the number of tasks submitted per day over the study period as well as the types of buildings submitted per group. The data hints at a possible strong correlation between groups with regards to the frequency of submissions per day; however, there is not enough data to conclude that it is significant ($r = .623$, $p = .135$). Additionally, the groups from this study tended to submit a disproportionate amount of smaller tasks (< 4 hours) which was also true from the previous study.

As with the last pilot study, participants were asked to participate in one of two semi-structured group interview sessions. In line with the previous study, participants were generally positive about interacting with the system and corroborated the responses given in the first study's interview sessions. Participants typically had different reasons for using Taskville. One participant, P1, liked to use it as a task logging tool which allowed her to reflect on her activity stating that she could "*[…] look at my sent things and take a look at the work I'd actually done to remind myself of when I actually did that stuff.*" P1 also noted that it was "*[…] fun to see how I rank among by peers in work*

ability." Another participant, P2, found that it acted like a *"[…] kind of mild motivator.*" This participant enjoyed the playful aesthetic of Taskville and found it to be non-threatening and relaxing compared to other workplace activities. Yet another participant, P3, focused on the competitive aspects of Taskville which were, once again, a very popular feature. P5 pointed out that the ability to view Taskville on a semi-public display *"[…] enhances the competitive nature of it because you […] see people clustering around and […] pointing things out. It's like, 'So and so got this now.'*" Participants revealed that the within group competition was, by far, the most relevant and engaging for them. This was attributed to being more familiar with the people and work being done within their own group which helped make the competition more fun and personal. P3 noted that, "*I don't know much, at all [of what is going on in the other location]; maybe that's why it's not as meaningful for me [with regards to the competition].*" However, as was expected, due to varying tastes and personalities, not every participant was engaged with Taskville. One participant stated that he "*[…] just didn't want to do the one extra thing to show that I did something. It really wasn't working for me. I wasn't really motivated by it.*"

With regards to the features that were added between studies, the tag clouds received the most praise. In general, participants expressed that the tag clouds were a nice feature and gave a nice overview of the work being done. P4 appreciated the tag clouds and stated that they gave "*[…] a creative overview of the tasks being done*" while P1 related that "*Watching the tag clouds was actually a lot more helpful to see what people were doing a lot of.*" Therefore, it seemed that the tag clouds were successful in conveying overall activity to the participants. Additionally, participants felt that the tag

clouds were sufficient in addressing the privacy issues that arose from the previous pilot study.

The pyramid gained from implicit collaboration (see Chapter 4.1.3.3) and the golden building rewards (see Chapter 4.1.3.4) were met with more consternation. The primary issue was that there was a lack of awareness of what these buildings actually were and how they were obtained. This made them ineffectual in motivating others to submit more tasks. P4 explained the problem succinctly: "*Not knowing what it meant or how it came about, there was like no motivation to see if I could get another one.*" Some of these problems stemmed from a deficiency in communicating these features to the participants. This resulted in some participants not knowing certain features existed, such as submitting collaborative tasks, until a few days after the study started. Overall, participants wanted future versions of Taskville to have more transparency in explaining how certain systems worked. Finally, the ability to submit explicit, collaborative tasks (see Chapter 4.1.3.2) was understood by most participants and was utilized as the study went on.

One of the most commonly requested features was to have additional ways to interact with the system. Many wanted a dedicated desktop client or a website that they could visit in order to view Taskville at their own leisure. This is due to the fact that many of these individuals also frequently work away from the office where they cannot view Taskville. Therefore, providing such a client would allow them to interact with it wherever and whenever they wanted. Another feature that was requested was the ability to view temporal information about the activity that had occurred within the game since it is not easy to discern from simply examining the visualization. Encouraged by the

success of these preliminary pilot studies, work was done to address the issues brought up by the participants and to explore new features towards conducting more, longer term studies.

4.2 Added Design Features

Based on feedback received from the preliminary, pilot studies and a desire to add more collaborative elements, a number of features were added to Taskville. These features introduce visual cues for collaboration, activity summaries to preserve individual privacy, a web interface, and other changes to the Taskville system.

4.2.1 Email and web interface. One of the issues with an increasingly distributed workplace and improved ICTs is that some workers do not spend a significant amount of time in their physical work location. Instead, they may choose to work from any number of locations whether that is from home, at a café, or even while traveling. Therefore, one of the most requested features from the study participants was the inclusion of a web interface for Taskville. While users were fine with viewing Taskville on the semi-public displays, they also wanted a means to interact with it anywhere at any time. Additionally, some users wanted additional ways in which they could submit tasks to the system. This was a sticking point for users who did not already have a Twitter account and did not feel comfortable in creating an account on a social networking platform.

To address these concerns, a component was created for the system that allowed users to submit tasks via email in addition to Twitter. To send a task through email, a user simply emailed ta dedicated Taskville email account and included the task information in the message body using the same syntax as before. Emails were filtered so that tasks

Figure 13. The website interface for Taskville. The top portion of the interface holds the visual portion of Taskville. Users can explore the city by clicking on tiles or dragging the mouse to move the camera around the game region. Below this are recent events that have occurred in the region. The bottom of the interface shows basic statistical information about the user and the currently focused city in the display. At the very bottom, users can submit tasks.

submitted in an invalid format are rejected. Emails which pass through the filters are retrieved by the Taskville server and processed normally.

A web interface, shown in *Figure 13*, was also implemented to allow for more ubiquitous interaction. In addition to allowing users to interact with Taskville at their leisure, the web interface also allowed for in-game activity and information to be more

Figure 14. A popup window showing the ranking of every user in a particular city.

easily conveyed. In the original version of Taskville, information could only be conveyed through viewing the visualization and reading the updates on the Taskille Twitter feed. While the visualization is effective in conveying the current state of the different groups, it does not convey any historical information. This may be disorienting to users who are not able to constantly view it since they have no way of knowing what changed in the cities between viewings. Therefore, the web interface provides some of this information to the user.

The web interface prominently displays the visual portion of Taskville in the upper half of the page. Below this is space for announcements which informs the user of the most recent activity. These announcements rotate over the last M messages over a fixed interval. Directly underneath these announcements is basic statistical information about the cities and the players that inhabit them. When the visualization portion of Taskville is focused on a particular city, the information in the web interface is updated to
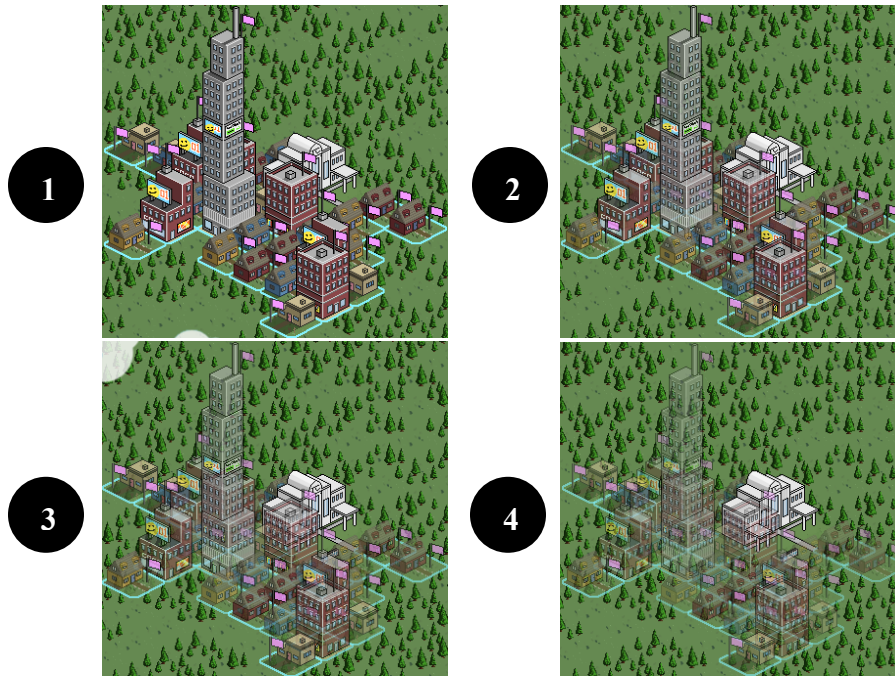
Figure 15. Buildings turning transparent over time due to the player being absent. As time progresses with no activity from the player, his or her buildings become more and more transparent.

reflect this. Particularly, the interface will list the four individuals in the city who are the mayor, deputy mayor, and city council members along with their scores. A link is provided which opens a popup window when clicked that shows the ranking of all users in this city as shown in *Figure 14*. Users can sort this list based on a number of factors such as by score, name, and the number of buildings that have been contributed.

Below this are three columns, organized as lists, which shows the latest buildings which were created in Taskville, the latest achievements which were unlocked by users, and a column which interleaves these two types of messages. Below these columns are links which allow the user to view all of the messages instead of the most recent ones. The purpose of providing this information is to present a news feed to the user which allows him or her to see what has changed since last visiting Taskville.

Finally, the web interface provides a form which allows users to submit tasks directly from it. This provides another method for the user to submit tasks in addition to the Twitter and email interfaces. Additionally, it is presented in a way that does not require the user to remember the task submission syntax.

4.2.2 Presence. Presence is an important aspect of workplace awareness and is intimately tied with it. For workplaces that rely heavily on collaborative work, knowing the location and states of certain individuals in the workplace can be valuable. By knowing this information, one can more easily integrate their activities with those of others while reducing the frequency of unwanted interruptions (Bardram & Hansen, 2010).

Research in human-computer interaction has examined how technological interventions can make an individual aware of the presence of others that can be used in various contexts. One popular use for presence technologies is in keeping track of family members and loved ones (Dey & de Guzman, 2006; Sellen, Eardley, Izadi, & Harper, 2006). Another popular context is the use of such technologies in the workplace which has been explored extensively. One of the earliest examples of presence technology is the Active Badge, which was a physical technology, similar to ID cards, carried by workers that were used for locating individuals within an office setting (Want & Hopper, 1992). Other research has examined the use of instant messaging clients as a tool for increasing group communication and raising presence awareness in the workplace (Handel & Herbsleb, 2002). More recent research has continued to examine the role of instant messaging in workplace presence awareness except now with the added sensing information (GPS, accelerometers, online connectivity, etc.) that is available from

smartphones (Biehl, Turner, van Melle, & Girgensohn, 2011). Other examples of presence awareness technology are found throughout the literature (Bardram & Hansen, 2010; Fogarty, Lai, & Christensen, 2004; Holmquist, Falk, & Wigström, 1999; Lee & Takayama, 2011).

In order to incorporate presence into Taskville, a module was implemented that provided a simple indicator for presence in the workplace. The module displays presence by making a user's buildings transparent ("ghosting") if a significant amount of time has elapsed since the submission their last task. The ghosting of buildings is an event that occurs over time rather than immediately. At a specified, constant interval, the system will make a pass checking which users are absent. For each of these users, a fixed percentage of buildings belonging to them are chosen. For buildings that have not been made transparent, a small amount of transparency is applied to them. For buildings that have already been made transparent, a greater degree of transparency is applied not exceeding a maximum transparency threshold. Buildings closer to the center of the city are affected first and the ghosting effect spreads outward over time. Once all of the user's buildings have been made transparent, a greater degree of transparency is applied once again starting from the center of the city and moving outward. *Figure 15* shows this progression over time.

4.2.3 Work/Life balance. Some participants from the pilot studies observed that Taskville focused exclusively on work and desired the ability to submit tasks that are associated with obligations and commitments that need to be met outside of the workplace. To accommodate these requests, the idea of work/life balance was incorporated into Taskville.

58

Work-life balance is a complex area of inquiry that has produced a number of models to define and explain this phenomenon (Guest, 2002). Sturges and Guest have shown that young professionals first entering the workforce place a high emphasis on maintaining a healthy balance between work and non-work life (Sturges & Guest, 2004). However, their research also showed that as these individuals' careers advance, they tend to work more hours and encounter more instances of their work lives interfering with their non-work lives (Sturges & Guest, 2004). Other research has corroborated these findings by showing that there is a link between hours worked and perceived work-life issues (Dex & Bond, 2005). Even more alarmingly, individuals who work longer hours tend to be more susceptible to detrimental health effects (Sparks, Cooper, Fried, & Shirom, 1997).

In order to address work/life balance, the latest version of Taskville now allows players to submit personal tasks in addition to work related tasks. Personal tasks represent activities that an individual does outside of the work that are necessary in maintaining a healthy lifestyle. Examples of these types of tasks include grocery shopping, doing the laundry, preparing dinner, partaking in hobbies, or even hanging out with friends. A quantitative approach to the issue of work/life balance is used in Taskville by constructing a ratio over the number of hours reported on workplace tasks and the number of hours reported on personal tasks. Taskville uses a ratio of 0.6 to serve as a baseline for work/life balance. If a player exceeds a ratio of 0.65, then he or she is considered to be working more than is healthy and should partake in personal activities in order to lower this ratio back to its optimal value. While this value of 0.6 is somewhat arbitrary, it corresponds to a 9 hour work day (9 hours out of 24) and is consistent with

Figure 16. The left image shows buildings which have not decayed. The right image shows the same buildings except they have been decayed.

the European Union's Working Time Directive which states that an individual should not work in excess of 48 hours per week (EU Directive 2003/88/EC, 2003).

If a player exceeds this ratio, then his or her buildings begin to slowly and visibly show signs of decay over time as shown in *Figure 16*. This serves as a metaphor for an individual not taking care of his or her life and allowing their work life to conflict and bleed into their personal life. The decay begins near the center of the city and spreads outward over time as long as the work/life ratio exceeds 0.65 which is similar to how the ghosting mechanic works. Each building can have three levels of decay and as the decay continues to progress, the building will move up to the next level of decay. The rate of decay increases based on how skewed the ratio is for the player. For example, a work/life ratio of 0.8 will result in the player's building decaying at a faster rate than if the ratio was slightly above 0.65.

A player can reverse the decay by returning to an acceptable work/life balance which can be accomplished by working slightly less and submitting more personal tasks

in order to lower the ratio back to 0.6. Once this balance has been reasserted, the buildings will begin to revert to their original form over time.

4.3 Longitudinal User Study

After these changes were incorporated into Taskville, a second round of user studies was conducted that was longer and incorporated more participants. The goal of these new studies was to further test the efficacy of Taskville as a workplace awareness tool as well as to determine if Taskville can be engaging over a longer period of time.

4.3.1 Methdology. Participants were once again recruited from a large, state university. Participants consisted of graduate students, staff, and undergraduate students that belonged to the same transdisciplinary school as from the pilot studies. A few of these individuals also participated in the one or both of the pilot studies. The recruitment protocol remained the same for non-undergraduate students in that participants were recruited through word of mouth, flyers, and email lists. Undergraduate participants were recruited from different courses being taught at this school, and were given a small amount of extra credit if they actively participated in a study. For these studies, an individual was defined to be an active participant if he or she submitted at least one task to Taskville. If a participant became inactive over time, an automated email was sent to him or her asking if they had any tasks to submit.

Prior to each study, participants who were tasked with using Taskville were given a brief description of the system and were told to interact with the system at their leisure once the study started. They were also asked to complete a pre-study questionnaire, similar in format and content as from the pilot studies, asking basic demographic information and their views on workplace activity. The pre-study questionnaire also

asked participants to reflect on their mood at work by rating multiple terms associated with emotion on a Likert scale. These terms were taken from a short form Positive and Negative Affect Schedule (PANAS) developed by Edmund Thompson (Thompson, 2007). Additionally, they were asked to complete a work goals survey which asked them to predict how many tasks they were going to complete in the upcoming week. A work reflection survey was sent out at the end of that week in order to get a gauge of how many of those tasks were actually completed. These same pair of surveys were also administered at the end each study.

At the conclusion of each study, a post-study questionnaire was administered to participants that asked for their feedback and to reflect on their work activity. This questionnaire also incorporated the System Usability Scale (Fogarty et al., 2004) which asks users to rate the usability of the system. All surveys used in these studies can be found in Appendix B.

4.3.1.1 First study participants and design. For the first study, 58 individuals registered to participate in it on the Taskville website. From this number, a total of 38 individuals actively participated in the first of these studies: 21 were undergraduate students, 15 were graduate students, 1 was an administrative staff member, and the final participant was a faculty member. Two of these participants were involved with Taskville in some capacity. To incentivize participation for non-undergraduate students, up to 10 $20 checks were offered to non-undergraduate participants contingent on how many points they earned in the game.

For the first study, we divided participants up into five groups based on the association between participants and where they were located on campus. The purpose of

62

First Study	Group	Undergraduate/ Graduate	N	Second Study	Group	Undergraduate/ Graduate	N
	A1	Graduate	9		B1	Graduate	6
	A2	Graduate	8		B2	Undergraduate	5
	A3	Undergraduate	13				
	A4	Undergraduate	7				
	Total		37		Total		11

	Group	Total # Tasks	Avg. # Tasks per User	Work Tasks	Personal Tasks
First Study	A1	205	22.78	160	45
	A2	508	63.50	304	204
	A3	131	10.08	118	13
	A4	119	17.00	69	50
Second Study	B1	265	44.17	149	116
	B2	94	18.80	70	24

Figure 17. Tables showing the number of participants in each group (top), and the number of tasks submitted by each group (bottom). The bottom table also shows the average number of tasks that were submitted by each user, the number of work tasks that were submitted, and the number of personal tasks

doing this was to simulate different co-located project groups in an actual workplace. The undergraduate participants were divided into 3 groups based on which class they were recruited from. The graduate student participants were divided into 2 groups based on where their work area was located.

Also for this study only, some of the undergraduate participants were asked to independently keep a log of the tasks that they completed using a diary booklet that was provided for them. This booklet provides fields for the participant to specify when the task was completed, a brief description of the task, and any extra notes that they would like to add. These participants were asked to turn in these booklets at the conclusion of the study. Unfortunately, few of the diary booklets were ultimately returned. Due to

scheduling issues, one group using Taskville was unable to participate until 3 days after the study started.

4.3.1.2 Second study participants and design. The second study had 11 individuals actively participate out of a total of 14 participants who registered for the study. 6 of these participants were graduate students while the other 5 participants were undergraduate students. Five of the participants who were active in the first study were also active in this study. For this study, monetary compensation was removed, but extra credit was still offered to the undergraduate students. The study was conducted over a period of 30 days, and participants were divided into two groups for this study: one for the graduate students and another for the undergraduate students.

A midpoint survey was distributed at the middle of the study that asked the participant to reflect on their workplace activity. These questions ask participants to specify when they have the most tasks to complete, at what times they are the most productive, and how long they typically spend on each task. The midpoint survey also used the same shortened PANAS questions present in the pre-study questionnaire. The purpose of administering this survey is to compare these results with those gathered from the pre- and post-study surveys which asked the same questions.

4.3.2 Study results and discussion. One group was omitted from the first study due to it only containing one member who submitted 3 tasks. From the remaining participants in the first study, 37 of those actively used Taskville (submitted at least one task) and contributed a total of 963 tasks over the duration of the study. 651 of those tasks were work related while the other 312 were personal tasks. For the second study, 219 work tasks and 140 personal tasks were submitted for a total of 359 tasks between 11
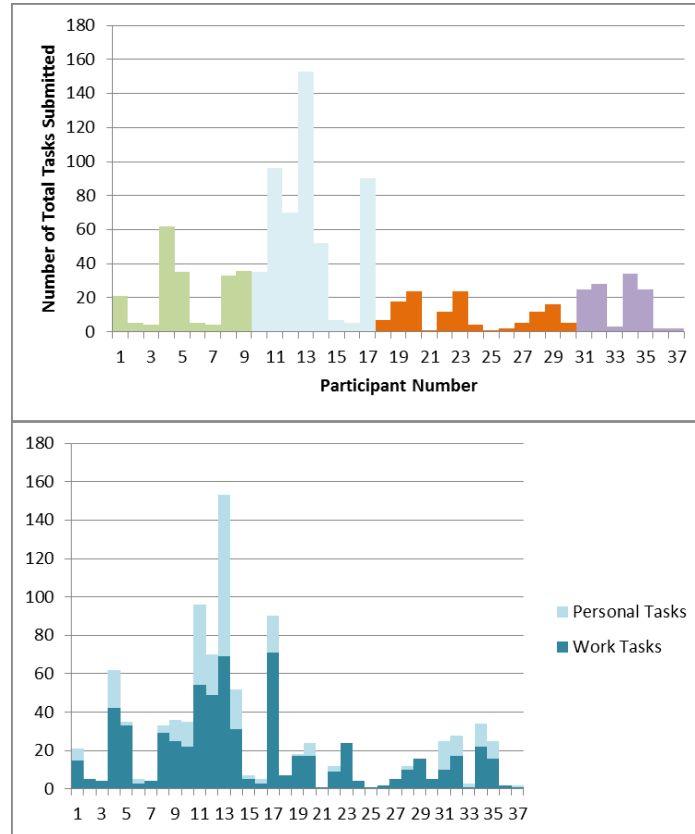
Figure 18. Graphs showing the number of tasks submitted per user in the first study. Top: The number of the tasks submitted per user with the colors delineating which group the user belonged to. Bottom: The number of personal and work tasks submitted per user.

participants. The number of tasks submitted in both studies is comparable despite the disparity in the number of participants. On average, each participant submitted 26.03 tasks in the first study and 32.64 tasks in the second study. *Figure 17* gives a summary of the number of participants in each group and the number of tasks that were submitted in both studies while *Figure 18* shows the distribution of tasks per user.

Overall, the number of task submissions shows that the rate of participation in both studies was quite high. The data also shows that the high number of task submissions was not isolated to only a few highly motivated individuals as *Figure 18* shows. The rate of task submissions also remained fairly stable throughout the duration of the study, and there was no evidence that there was a significant drop off in participation

as the study progressed. In the first study, only the graduate group, A1, had declining participation as the study continued. In the second study, the graduate group, B1, also had declining participation over time. Overall, this suggests that Taskville's design is successful in keeping individuals continually engaged with the game.

When examining the number of work related tasks which were submitted per day between each group, the two graduate groups, A1 and A2, were found to be moderately correlated with each other (r=.61, p < .01). Additionally, there was evidence suggesting that the graduate groups were correlated with one of the undergraduate groups, A3, although the results were not significant (r=.380, r=.364, p < .1). Neither of these groups was correlated with the activity from the other undergraduate group, A4. However, this can potentially be explained in that A4 represents undergraduates in a 100 level introductory college course. Therefore, the volume and type of work that they do is different from the work that their older undergraduate and graduate peers do on a day-to-day basis. A moderate correlation was also found between the two groups in the second study, B1 and B2 (r=.394, p < .05). Work tasks are only examined due to those being the tasks which are visible on the display unlike personal tasks which only serve to prevent building decay and have no presence in the game. Additionally, other players are notified when these tasks are submitted through messages that appear within the game and website.

The post-study questionnaire also queried participants about the usability of the system and their thoughts of it as an awareness tool. A total of 16 participants responded to this questionnaire across both studies (14 participants in the first study and 2 participants in the second study), and these results were combined when analyzing the

data. The system usability survey asks users to rate a system based on 10 prompts on a 5 point Likert scale. The results from the post-study questionnaire indicate that Taskville is extremely easy to use and understand, and the system received an average score of 88.13 (SD: 8.19, N = 16) out of 100 which is extremely high. However, there were a few areas that could have used improvement. One participant explained that they *"[…] didn't like the navigation between cities and didn't find it intuitive. I kept clicking on the minimap thinking it would take me to that city."* Small issues like these can be improved upon in future iterations, but overall, the results show that Taskville succeeds in two of the heuristics that it set out to achieve which is to have *simple ubiquitous interaction* while having *simple rules*.

Responses to other Likert scale questions show that Taskville is also effective in other areas. Many participants found that Taskville was extremely fun to use (M: 4.50, SD: .63) and indicated that they would be willing to use it again in the future (M: 4.69, SD: .48). Additionally, participants responded that they would recommend Taskville to others (M: 4.56, SD: .51). This suggests that the design of Taskville succeeds in being fun for many individuals. This is corroborated by some of the feedback given in the questionnaire when asked about what they liked about Taskville as many participants listed the ease of use and fun of the system as two of the main draws. Participants *"[…] loved the how simple it was to use and how fun it was"* and also appreciated the *"game-like feel"* of Taskville. Overall, these responses indicate that Taskville is successful in being fun and that another heuristic was successful which is to *provide responsive feedback* to the player in order to keep them engaged. It also demonstrates that gamification strategies can be effective in awareness systems.

67

Although Taskville exceeds with regards to the interaction and engagement design goals that were set out for it, future versions of Taskville need to place more emphasis on the set of design goals that address social awareness and cohesion. As an awareness tool, its *raison d'etre*, Taskville received a mixed reaction from participations. Taskville was found to be successful as an *individual* awareness tool. Participants found that Taskville was successful in making them more aware of the amount of work that they do (M: 4.19, SD: .91) and what tasks they have been working on (M: 3.88, SD: .89). Participants also indicated that Taskville gave them more motivation to complete their work (M: 4.06, SD: .85) which was another overall goal of Taskville. One participant noted that they liked *"having Taskville as a reminder of 'have I completed any tasks lately?' helped me stay focused and motivated me to complete work."* However, participants did not feel that Taskville was as successful as a *group* awareness tool. Participants did not believe that Taskville made them more aware of what others were working on by just looking at the visualization (M: 2.75, SD: 1.0). A participant explained that *"the […] only way to get a sense of the tasks is through the [tag] cloud but you have to wait for that to appear and it can take some time."* Another issue that may have resulted in Taskville not being perceived as a successful group awareness tool may be due to the actual utility of the visualization itself.

One of the heuristics for Taskville was to make it *visually appealing* and *understandable*. Based on feedback from participants, Taskville succeeded in the former but struggled in the latter. On the questionnaire, participants indicated that the city building metaphor made sense and was resonating with them (M: 4.13, SD: .81). Additionally, the visual aesthetic of Taskville was praised by multiple participants. One

participant noted that Taskville had *"good visuals"* while another stated that they liked *"[...] the SimCity-ish concept [...]."* Another participant went further saying that *"[...] there was something aesthetically pleasing to seeing the buildings float in when a new task was entered."*

Although Taskville succeeded from an aesthetic point of view, there was a mixed reaction with regards to the utility of the visualization. Participants indicated that they were able to easily identify which buildings belonged to which cities (M: 4.38, SD: .81). However, participants were lukewarm when asked if they were able to, in the visualization, identify which buildings belonged to them (M: 3.31, SD: .95), which buildings belonged to other players (M: 3.31, SD: .87), and the number of tasks that they completed (M: 3.27, SD: 1.28). Many participants in the questionnaire further explained why this was not working for them. One participant observed that *"[...] it was somewhat hard to tell which buildings belonged to whom at first glance, as I had to look closely at the flags,"* and yet another stated that they *"[...] could not see or find [their] own buildings at times."* One participant gave a more in-depth explanation of this issue:

> *I wish I could have seen more of the buildings I built, especially the houses. Most of the shorter-time achievements (houses) got masked by the longer term achievements, whereas, my work habits are organized in small chunks vs. large ones. So I stopped feeling like I wanted to enter things in unless they were major (long) accomplishments. Also, I wanted to know more about my own work habits, but I couldn't see a list of my tasks, nor could I see my own area of the town.*

It is apparent that this is an issue that needs to be addressed. As cities grow larger, the city becomes more cluttered and participants rightly note that this makes it difficult to

understand what is happening in the city. Adding a feature that allows players to rotate the city would allow them to see buildings that are hidden behind larger buildings. Adding additional spacing through varied terrain elevation and separating neighborhoods by roads would also help in minimizing the cluttered look of a city when it grows larger.

Many personal tasks were submitted throughout both studies which show that players are interested in submitting these types of tasks alongside work related tasks. However, some found the mechanic slightly confusing or found that the buildings decayed too quickly over time. These types of problems can be addressed with some tweaking in future iterations of Taskville.

4.4 Discussion and Conclusions

In Chapter 1, three questions were presented which described challenges that face a modern, distributed workplace. These questions are reiterated below:

- How and what are we doing?

- What is my contribution?

- Are we having fun yet?

Overall, the study results from the pilot and longitudinal studies show that Taskville was successful in addressing these three questions. The following sections represent three broad areas of inquiry that Taskville sought to address through these studies. Within each section is a discussion on how they contribute towards answering the three above questions.

4.4.1 Effectiveness of design and heuristics. Chapter 3 described a set of eight heuristics which were developed to create workplace games for raising awareness. The studies affirmed the belief that these heuristics are very successful in guiding the

development of fun, engaging, and usable workplace situated games. The evidence for this is in the very high scores that Taskville received on the System Usability Scale, the consistency of task submissions throughout the studies, and also by the overwhelmingly positive feedback that was received with regard to the gameplay elements that were incorporated into the system. There was only a noticeable drop off of activity in Taskville for one graduate group in each study. With regards to feedback, many participants in both the pilot and longitudinal studies praised the incorporated gameplay elements and found that the system was very fun to use. For example, one participant stated that they *"[…] loved completing tasks – especially big ones – and seeing the payoff visualized as a large building. It made completing tasks fun."* These responses were not uncommon throughout both studies. Another participant, in particular, enjoyed the in-game achievements that could be unlocked and stated that the *"[…] achievements were a nice feature that had me thinking about how to enter tasks to see if I could unlock more."*

Another gameplay element that was lauded in both the pilot and longitudinal studies were the competitive features present in Taskville. A player from the longitudinal studies expressed his/her enjoyment of the competitive features by stating that they *"[…] felt motivated to become the Mayor."* Yet another player stated that *"[…] competition aspect was [his/her] favorite part."* In fact, this same individual indicated that they wanted more competitive elements in the game:

There could be an interesting dynamic in having an overall "president" of Taskville (across cities) based on point values. Maybe this president would have access to some new game mechanic such as selecting new achievements for the

71

other cities, etc. This might add a competitive drive for people to keep accumulating points.

Based on the positive feedback overall with regards to this aspect of Taskville, the results from these studies indicate that a gamification approach can have a significant impact on making a workplace system fun and engaging for long term use. This was the rationale for including the heuristic that was related to competition (providing a *lightly competitive* environment). Therefore, it can be shown that Taskville successfully addresses the question: *Are we having fun yet?*

4.4.2 Effectiveness as an awareness tool. The study results also proved that Taskville has the potential to be successful as an awareness tool. The pilot studies demonstrated that individuals are not overly aware of how many tasks they complete on a given day and how long they spend on them. The pre- and post-surveys from these initial studies also indicated that Taskville was able to raise awareness. Results from the surveys in the longitudinal studies affirmed that Taskville was effective in this regard as participants indicated that it succeeded in making them more aware of their activities and motivated them to complete tasks. Therefore, Taskville successfully answers the question: *What is my contribution?*

With regards to group awareness, Taskville met a fairly mixed reception. As mentioned earlier, feedback from the longitudinal studies indicated that participants viewed Taskville as fairly ineffective as a group awareness tool. However, the correlations of activity that were found between groups suggest that this answer might not be as straight forward as it seems.

The correlations are interesting in that it suggests that there is some "back and forth" occurring within the game. In other words, when one group submits tasks, it may compel other groups to also submit tasks afterwards. This type of back and forth activity was also evidenced in the pilot studies although not enough data was collected to show that it was significant. This could imply that the competitive elements of Taskville are having an effect in keeping users engaged with the system, but it also implies that users are *implicitly aware* of activity occurring in the workplace. Due to not wanting to be seen as lagging behind their peers in other groups, players may feel inclined to submit tasks if they notice others doing so, especially from other groups. One participant's response indicated that the competition helped foster activity awareness: "*I enjoyed the competitive aspect of it. There were definitely different moments with collaborations during the study in which the tasks were discussed in terms of the implications they would have for points [in our city].*" In this scenario, one has to be aware of what activity is occurring in the city in order to have these types of discussions. Therefore, the competition seems to be directly contributing to making users aware of workplace activity.

Although participants may not believe that Taskville is successful in making them *explicitly aware* of the activity that is occurring around them through the visual interface; the competitive elements seem to be making them *implicitly aware* that some broader activity is occurring even though they may not be able to pinpoint exactly what this activity is. Therefore, if this true, then Taskville is somewhat successful in addressing the question of *How and what are we doing?* Further improvements need to be made to the visualization portion of Taskville to make peer activity more visible and understandable. The correlations that were found also need to be investigated further to ascertain if they

are indeed an indicator of individuals being aware of workplace activity or if they exist due to some other reason. However, preliminary findings point towards the former.

4.4.3 Coordination and community building. Another aspect that Taskville sought to explore was whether it would be successful in coordinating activity and building community in the workplace. This was related to the question of *How and what are we doing?* The purpose of including the collaborative buildings and having it viewable on large, semi-public displays was to study this dimension. One participant from the pilot studies related that after class, they would "*[…] always end up clustering [at the display] and kind of talked about it.*" This shows that Taskville has the ability to facilitate water cooler style conversations around it in the workplace which can be an effective way to strengthen community ties in the workplace. Future studies should extensively examine the role of large, semi-public displays on community building.

Another indication that coordination is occurring within Taskville is the correlations that were found between groups as discussed in the previous section. However, this could potentially be only an individual reaction to activity occurring rather than as a deliberate coordinated action within the group. Overall, though, the studies conducted as part of this thesis do not adequately address the question of whether or not Taskville was successful as a coordination and community building tool. One problem is that there is not much incentive to submitting collaborative tasks in Taskville, and another problem is that collaborative tasks are currently limited to only those that occur within a group. This could potentially explain the relatively low number of collaborative task submissions across the studies (8 in the second pilot study, 43 in the first

longitudinal study, and 0 in the second longitudinal study). These issues need to be addressed and these questions revisited in future iterations and studies of Taskville.

CHAPTER 5

DEVELOPMENT OF EVALUATION TOOLS

Future longitudinal studies involving Taskville should examine if raising awareness in the workplace corresponds to an increase in productivity and morale. When preparing to conduct such a study, two questions must be addressed: 1) What study techniques/methodology is best suited for examining these factors and 2) Are there any existing tools that aid researchers in conducting these studies?

With regards to the first question, studies that examine these types of factors often use the experience sampling method (described later in this chapter) which relies on repeated sampling and/or paper diary/survey booklets. However, these studies require a significant amount of due diligence from both the researchers and participants. In this scenario, the researcher must remember which surveys are to be administered at certain times and to whom, and then send reminders out to these participants if necessary. If participants are in different time zones, this can be a logistical nightmare. With regards to paper diaries and surveys, these can be a burden to both the researcher and the study participant. For the study participant, it is an extra item that needs to be carried around and takes up space which may affect their willingness to participate and stick with the study. For a researcher, it's an item that needs to be distributed and collected in person which can be inconvenient and time consuming. Additionally, data cannot be analyzed as the study progresses due to having to wait for these materials to be returned. Unfortunately, there are not many (if any) up to date tools that reduce the impact of these problems.

Therefore, effective digital tools that address these issues can be extremely valuable when conducting these types of studies. Towards this end, this chapter describes such a tool, named Studious, which was developed to help automate many of the tedious aspects present in these studies. Studious also removes the need for paper surveys and diaries by moving them onto a website which removes a significant burden from both the researcher and study participant. This chapter will begin by exploring existing methods on measuring productivity and affect and explain why the experience sampling method and its variants are best suited for this task. The chapter will then describe Studious in detail and explain how it can be useful for these types of studies.

5.1 Measuring Productivity and Affect

Many existing evaluation tools for the workplace are physical surveys that ask supervisors to rate their employees (Hoffman, Nathan, & Holden, 1991). However, this is very burdensome for the supervisor, especially if these evaluations are needed at multiple points of time. Unfortunately, asking workers for subjective responses on their own workplace productivity or ability is not a common practice unless used in conjunction with other measures for validation. This approach is problematic for a number of obvious reasons; foremost being that individuals tend to perceive that they are more productive than they really are and will overstate their performance when asked (Hoffman et al., 1991; Mabe & West, 1982). The other problem is that these measures tend to be designed for one-time use with no regards to temporal effects.

One method in which performance levels can be compared against is by measuring affective responses by the individuals. Within the context of this work, I use "affective response" as a catch-all for a wide range of concepts that encapsulate positive

and/or negative affect such as happiness, subjective well-being, etc. Various research studies have examined the effect that these various indicators have on productivity which has produced a variety of contrasting opinions. While there is still considerable debate over whether or not a link exists between productivity and emotional states like happiness (Ledford Jr., 1999), some research has suggested that affective states can have a discernible impact on other aspects of workplace performance such as creativity (Amabile, Barsade, Mueller, & Staw, 2005; James, Brodersen, & Eisenberg, 2004). Affect can also have wide ranging effects on a multitude of other factors in the workplace as well which can include cooperation and evaluation (Brief & Weiss, 2002). Therefore, measuring affect can be a way to better understand and analyze workplace performance.

Many survey tools have been developed to measure individual affective states which have had a rich history in social science research. These can be multidimensional measures as is the case with the highly influential Positive Affect/Negative Affect Schedule (PANAS) (David Watson, Clark, & Tellegen, 1988) and its many variants (Thompson, 2007; D. Watson & Clark, 1994), or they can be single dimensional such as with a simple, modified Faces scale (Dunham & Herman, 1975). Many more examples of both can be found throughout the literature.

However, the problem with these existing sampling methods is that they only represent a single snapshot of an individual's emotional state. As any human being can attest to, emotions are extremely fluid and change based on a number of biological and external influences. In other words, emotions fluctuate over time which cannot be captured by older tools that measure affective responses. This problem can be addressed by repeatedly administering the same survey over a larger period of time which will

capture temporal data in addition to measuring affect. This approach is the basis of the sampling method developed by Mihaly Csikszentmihalyi and his colleagues which is the aptly named experience sampling method (ESM) (Csikszentmihalyi & Larson, 1987).

The experience sampling method takes into account temporal fluctuations in one's mental processes which can include affective states (Csikszentmihalyi & Larson, 1987). ESM works by having participants complete a survey as soon as possible after being signaled (via email, text message, phone call, etc.) to do so. This survey consists of basic questions that ask about what their current activity and mental state. Other items on the form vary based on what data the researchers are looking for. This process is repeated with the same survey throughout the study's duration which may last any amount of time. The number of times that the survey is administered is dependent on the type of study being conducted. However, one key aspect of ESM is that the surveys are not distributed at set intervals. Instead, the surveys are sent out within certain timeframes to compensate for any bias that may affect the results due to the user routinizing the activity of completing the survey.

More recently and along a similar vein, the use of Ecological Momentary Assessment (EMA) has been investigated which is a collection of methodologies which share many of the same principles as ESM with some differences (Shiffman, Stone, & Hufford, 2008). EMA allows for repeated, random sampling, sampling when relevant events occur, or a combination of these sampling methods. Additionally, EMA utilizes the affordances of modern computational technology in order for more complex, meaningful surveys to be used and to ease the process for both researchers and participants.

However, ESM has a number of limitations which were enumerated by Scollon et al. (Scollon, Kim-Prieto, & Diener, 2003) which will briefly be reiterated here. For one, due to the semi-randomness of the survey, events that a researcher may be very interested in may not be captured due to it occurring at a time outside of when the participant was signaled. Additionally, there may be significant biases introduced to the data by using this method. These can include anticipation and reflection biases where the participant begins to anticipate when they will be asked to complete the survey and/or become more self-aware of the survey and responses they give. Both of these cases may color how participants respond to the surveys and introduce significant bias in the data. Another problem with ESM is that it can be quite demanding for the participant, due to high frequency in which they must complete the survey. This can lower the rate of retention and can introduce a situation where only highly motivated individuals may complete the study which will not give a representative sample of the population being studied. These issues along with others are discussed in more detail by Scollon et al. in their work.

The Day Reconstruction Method (DRM) developed by Kahneman et al. is an alternative approach to ESM which also seeks to capture momentary experiences while addressing its problems (Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004). With DRM, participants are asked to reflect on the *previous* day's episodes (events), record them, and answer questions regarding the situation and their emotional experiences for each episode (Kahneman et al., 2004). DRM is less intrusive and burdensome to a participant than ESM in that participants are only asked to complete a survey once per day rather than at multiple instances throughout the day. Additionally, DRM allows for any event to be captured due to it encompassing an entire day which ESM does not do.

Finally, Kahneman et al. show that the effectiveness of DRM as an assessment tool is on par with ESM.

With regards to Taskville, DRM can be an effective tool in determining if using Taskville has any effect on workplace performance, mood, or job satisfaction. However, administering studies that utilize DRM or ESM can be tedious for the researcher. Paper copies of surveys must be made and distributed to participants. Additionally, reminders must be repeatedly sent to numerous participants at set times which is repetitive and troublesome. Unfortunately, there are not many generalized, computational tools available for administering these types of studies. Therefore, Studious was developed for future Taskville studies in order to automate many of the tedious aspects of the DRM and ESM approaches. With Studious, researchers can create a website and quickly construct surveys; subscribe participants to their studies; and schedule email and text message reminders to inform participants when to complete these surveys.

5.2 Related Work

There currently exist few computational tools that can be used to administer a study based on the DRM and ESM methodologies. MyExperience is a platform, influenced by ESM, which was developed for mobile devices that administers surveys based on the participant's context. (Froehlich, Chen, Consolvo, Harrison, & Landay, 2007). Froelich et al. give an example of where a participant is randomly sent a survey immediately after they conclude a phone call. MyExperience uses triggers (time-based events or sensor state changes) that specify when an associated action should be performed. An action can include displaying a survey to the user. However, setting up these triggers and actions require some knowledge of programming as they are set up

through code. Studious, on the other hand, strives to obfuscate code wherever possible and allows study administrators to set all of the essential parameters of a study through a graphical user interface. Similar, context-aware ESM prototypes were also explored by Intille et al (Intille et al., 2003).

Momento is a computational tool which has many of the context-based features of MyExperience but with the added benefits of being more user friendly and having additional features (Carter, Mankoff, & Heer, 2007). Momento is a catch-all system that can be used to capture qualitative data in a variety of study settings which can include studies utilizing ESM. The system consists of a desktop client application that is used by study administrators and a mobile client application which is used by study participants. Using the desktop application, study administrators can specify participants and groups, locations, and rules specifying in what situations and times messages be sent to a particular participant. Studious differentiates itself from Momento in that it uses a shared web application for serving the needs of both the study administrators and study participants. Because Studious is exclusively web-oriented and utilizes SMS messages, the need for desktop and mobile client applications is eliminated. Additionally, Momento is no longer supported.

5.3 Studious Evaluation Tool

Studious is a web-based survey tool that was developed to help researchers conduct studies that use the experience sampling methodology (or similar variants thereof). It was specifically created for use in longitudinal Taskville studies that use the day reconstruction method, but it can be easily adapted for other contexts. Studious is a

Ruby on Rails plugin/gem that can be used in any Ruby on Rails developed website and adds out of the box functionality for researchers to create and manage ESM-like studies.

Studious consists of three primary components. The first component allows a researcher to create surveys that will be used in their study. The second component is the administrative interface which allows a researcher to subscribe users to his or her study and to also manage when surveys will be sent out. The final component is the actual survey interface which allows users to complete these surveys.

5.3.1 Survey design and creation. Currently, Studious does not provide a graphical user interface that allows a researcher to create a survey a la SurveyMonkey or the survey form generator that Google Drive provides. This is a feature that is intended to be implemented in future versions of Studious. However, researchers can create surveys on the web server through use of the command line interface. Studious provides a Rails generator which creates a stub YAML file from which the researcher can specify basic configuration options and define the questions that make up the survey. The YAML format was chosen because it is cleaner and slightly confusing for a layman to understand due to the format forgoing the use of angle brackets and start/end tags.

In the configuration section of the survey document, the researcher specifies the name of the survey, an optional time-to-live (TTL), and the type of survey it is. The TTL specifies how long a user has to complete the survey after it has been distributed to him or her. For example, a TTL of 10 means that after a user receives a notification to complete the survey, he or she has 10 minutes to complete the survey. After the TTL has expired, the user will not be able access the survey unless they receive another notification in the future to complete it.

83

A survey can be one of many types, and the survey type mostly specifies when survey reminders will be sent to study participants. In ESM-like studies, the same survey is typically sent out periodically at one or several points during the day. To accommodate this, Studious provides various survey types that define when reminders for that survey should be sent out if any at all. All of the types currently supported in Studious are listed below along with a brief description of each.

- *no_reminders*: This is a survey where a user must be subscribed to the survey in order to complete it. However, no reminders are sent to any of the subscribers.

- *public*: This is a survey which can be accessed and completed by anyone who has a link to the survey.

- *exact_per_user*: In this survey, every subscriber has a set of exact times in which they should receive a survey reminder.

- *exact_all*: A survey reminder is sent out to every subscriber based on the reminder time(s) specified by the study administrator.

- *range_per_user*: Every subscriber has a set of unique time ranges in which they should receive survey reminders. For example, if a particular subscriber to the survey specified a time range from 7:00 AM to 5:00 PM in which to receive a survey reminder, then that subscriber will receive a reminder at some time within that range. Multiple ranges can be specified.

- *range_all*: A reminder is sent out to each subscriber based on a time range specified by the study administrator. For example, if 7:00 AM to 5:00 PM is

the range specified by an administrator, then every subscriber will receive a reminder at some random time between 7 AM and 5 PM.

After the configuration portion of the survey, the researcher can now specify the questions that will comprise the survey. In Studious, surveys consist of several sections with each section containing one to many questions. For each section, a researcher can specify if the section should be on a new page or not. Additionally, a section can be set to be repeatable in that the user taking the survey can repeatedly answer the same questions in the section on the same survey as many times as they want. This can be useful for situations where there can be multiple answers to the same question that the researcher wants to capture. For example, in a typical DRM survey, the study participant is asked to list all significant events that occurred in the previous day and to rate each experience by answering a set of questions for each event. In this situation, the researcher does not know how many events will be listed which is entirely up to the whim of the participant. In this example, using Studious, a researcher can define a section that contains a number of questions asking the participant to describe one event and to rate their experiences of that event. If this section is declared to be repeatable, then the study participant can click on a "Repeat Section" link to have the section repeat itself so they can add another event.

Finally, a section can be set to be in response to a previous question in the survey. For example, suppose that there was a question which asked the study participant to list their favorite movies. In addition to listing these movies, the researcher also wants the participant to rate each movie on the next page of the survey. The researcher can accomplish this by setting the section that contains the rating question to be a response to the question asking the participant to list their favorite movies. When the participant takes

the survey, they will list all of their favorite movies and when they go to the next page, each movie that was entered will be shown along with a question asking them to rate each of them. This is demonstrated in *Figure 19*.

Within each section, the researcher specifies the questions that belong to it. Each question can be listed as being required or not. If a question is required, then that question must be answered by a survey taker before moving on to the next page or submitting the survey. Studious currently supports several types of questions with each question type having its own set of unique properties that can be modified. The list of question types currently supported is as follows:

- *Multiple choice*: A survey taker can select one answer from multiple options.
- *Multiple selection*: A survey taker can select 0 to all of the answers presented to him or her (e.g. check all that apply).
- *Single line text response*: A survey taker gives a one line response to the question.
- *Free response*: A survey taker gives a lengthy text response to the question. The number of columns and rows of the text box can be specified by the survey creator.
- *Likert scale:* A survey taker chooses a score from M to N where M < N. For example, a standard Likert scale will have a range from 1 to 7. M and N can be specified by the survey creator.
- *Range:* Similar to the Likert scale but meant for a larger range of values (e.g. choosing your year of birth from a list of years ranging from 1900 to 2013). The choices are selectable from a drop down box.

Figure 19. A survey with questions that depend on the responses from a previous question.

- *Instruction:* Not a question but provides additional text if further instructions are needed at certain points in the survey.

Appendix B provides an example survey file which demonstrates the different configuration options and the different types of questions that can be added to a survey.

The example file also shows how a survey should be laid out from a formatting point of view.

     5.3.2 Administrative interface. Once a survey has been created, the administrative interface allows a researcher to subscribe participants to their study and to set up times for when participants should be reminded to complete a survey. *Figure 20* shows the interface that displays all of the surveys that have been created by the researcher.

Figure 20. An administrative page of Studious. This page shows all of the surveys that have been created and the users who have been subscribed to them. A researcher can add more subscribers by clicking on the "Subscriptions" link.

     From here, the researcher can click on the Subscriptions link which will take them to a page where they can subscribe registered users to their survey. If the survey type supports it, the researcher can also specify an exact or range of times in which a reminder should be sent out to the participants subscribed to the survey. Alternatively, if a participant specified a list of times they are available when registering for the study, Studious will generate reminder times based on that information. Based on these times, Studious determines when each subscriber will receive a reminder. Once a reminder has
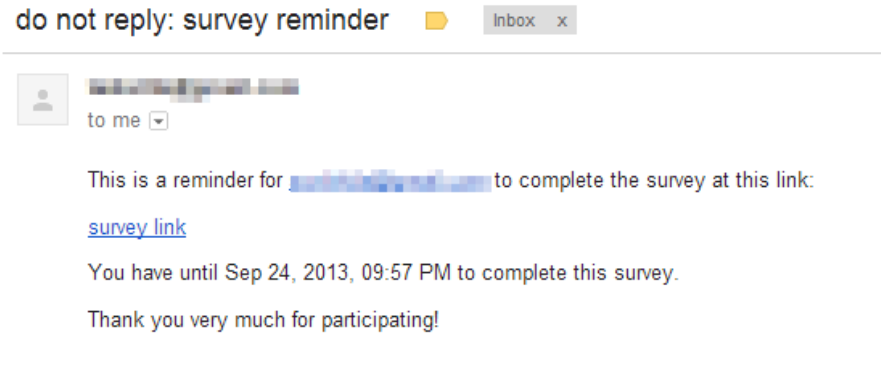
Figure 21. An email reminder sent to a participant asking them to complete a survey.

been sent out for a user, the system then determines when the next reminder will be sent for that participant.

5.3.3 Survey interface. Once a study participant receives a reminder to complete a survey (or if the survey is public), the participant will ideally complete the survey. The reminder is sent by email and also by text message if a phone number was provided by the participant. The reminder message that is received by the participant is shown in *Figure 21*. The study participant can then follow the link to the survey form and then complete it. The actual survey form looks very similar to other popular survey tools like SurveyMonkey, and *Figure 19* shows what a Studious survey form will typically look like. Of course, the aesthetic style of the survey form can be modified by overriding the default CSS.

5.4 Summary and Conclusions

Studious is a Ruby on Rails gem/plugin by providing functionality that enables a researcher to more efficiently conduct ESM-like studies. Specifically, Studious aims to reduce the tedium associated with these types of studies by moving the surveys online and more importantly, automating the process by which a participant is reminded to

complete these surveys. By doing so, Studious negates the need for paper booklets and allows the researchers to focus their efforts on other aspects of the study which can result in significant cost and time savings for all parties involved. Studious will be leveraged in future explorations with Taskville in ecologically valid contexts. This planned future work is discussed in more depth in the next chapter.

CHAPTER 6

FUTURE WORK

The pilot studies and longitudinal studies demonstrate that Taskville was successful as an awareness tool for the workplace within the specific context it was situated in: the university with students. However, further longitudinal studies must be conducted to show that Taskville can be an effective as an awareness tool. Ideally, these studies will be conducted over the course of a year and would be situated in actual, real world workplaces. These can include typical office workplaces but can also be expanded to include more blue-collar workplaces such as production facilities. This would provide an interesting contrast to see how well Taskville would perform in different types of workplace environments. One of the shortcomings of the Taskville studies was that it focused almost exclusively on college aged students who are known to be particularly tech savvy. Future studies should incorporate participants who come from a wide variety of backgrounds and ages in order to see how well Taskville is received by them.

Additionally, future longitudinal studies should examine whether or not Taskville is successful in influencing behavior in the workplace. The correlations that were discovered during the longitudinal studies indicate that awareness of activity in Taskville may influence others to participate as well. Therefore, these correlations should be further investigated in order to concretely identify why they are occurring. Further studies should also examine if being aware of workplace activity with Taskville results in increased productivity and morale. Discovering such a link would have significant implications on how games can be effectively used in the workplace.

Feedback from the studies also indicates that work needs to be done to improve the group awareness aspect of Taskville. As was discussed in Chapter 4, many participants found it difficult to identify buildings and who they belonged to which may have contributed to this problem. This is because buildings became highly clustered together as the city grew which made it look like a large, condensed blob on the landscape. This can be accomplished in any number of ways, but three potential solutions come immediately to mind. First, the visual clutter that obscures information in cities that grow sufficiently large must be addressed. Providing variable height terrain, impassable terrain, and a city blocks structure to the cities would force the buildings to be further separated making it easier for the player to understand what is occurring in each city. Second, submitted tasks can be presented in a more traditional, user friendly list-based format to complement the visualization of the cities. This would give users another viable modality for understanding what is occurring in the cities and was requested by one of the study participants: *I would like more features that let me see the distribution of task types I have entered and others have entered.*

Another aspect that needs to be addressed in future versions of Taskville is its scalability. In Taskville, each task represents one building which is problematic if the same city exists over a span of several years and/or several thousand tasks were submitted. One way that this can be addressed is by having a goal setting system within Taskville. Using this scheme, a building would represent a longer term task that consists of multiple subtasks. The building would be considered under construction until all of the subtasks were completed. This would help reduce the number of buildings in the game and thus improve scalability.

Finally, more customization and gameplay features should be added to Taskville which are the two most commonly requested features. Building themes can be incorporated into the system where a player can choose to have their buildings look like Greco-Roman buildings, futuristic buildings, medieval buildings, etc. Alternatively, functionality can be added that allows players to paint their buildings different colors which will give players a feeling of unique ownership with their buildings. This would also help players more easily identify other players' buildings. One study participant suggested an urban planner tool that allows players to add *"[…] more variety of what gets built (e.g., parks, malls, building styles, apartment complexes."* Another participant suggested *"[…] a garden, forest, or farm version of Taskville, where maybe, you get to cultivate your garden or create a more nature-like or sustainable eco-system."* Therefore, there are a variety of options that can be explored in order to add more customization to Taskville.

With regards to gameplay mechanics, many participants throughout these studies complained that Taskville did not go far enough in incorporating gameplay elements into the system. One participant was not very satisfied with Taskville and stated that there was *"not enough motivation. Needs more than just placing a building. Should be more competitive. Add more gameplay elements. Should be able to do things in the game besides adding houses."* Another participant enjoyed the simplicity of it but also wanted deeper mechanics: *"Maybe if you're mayor you can restructure or do zoning … all sorts of complicated things that I'm sure would take much time to implement."* Therefore, additional gameplay mechanics can be incorporated carefully into Taskville to increase engagement to the system. Giving unique powers to the mayor and/or providing simple

zoning rules for the buildings are simple mechanics that can be added. However, care must be taken to avoid adding too many gameplay mechanics that can make the system distracting in the workplace or alienate users who are not well versed in games. Overall, there are many aspects of Taskville that can be improved upon to create a better and more effective user experience.

CHAPTER 7

SUMMARY OF CONTRIBUTIONS AND CONCLUSION

The concept of remote work is currently at a crossroads in today's modern workplace. Information and communication technologies have advanced to a point where it is entirely feasible for a team to successfully complete a project from start to finish with every team member being located at a different geographical location. The development of cloud computing, the continued perfection of remote video conferencing, distributed project management suites, etc. have all contributed in making this possible. However, at these crossroads is uncertainty in which direction we should go. Businesses and researchers alike are continuing to struggle in determining what tradeoffs exist between remote work and more traditional, co-located work. What is the perfect balance between these two modalities of work and how does this affect the individual worker?

However, this also provides an opportunity to examine new and innovative ways in which collaborative work can be supported beyond the common technologies currently in use today. For example, sophisticated remote presence devices are entering the commercial market which allows a worker to see, speak, and move around the office in real time even though the worker may currently be thousands of miles away (Ward, 2013). This is the context in which Taskville was developed in that it supports collaborative work by raising workplace awareness in a manner that is quite unique and unorthodox compared to other systems. Specifically, the research presented here postulated that gamification strategies can be quite effective in accomplishing these goals.

Therefore, to explore these issues, and to summarize the contributions of this thesis, a general design methodology was created and used for the development of

95

workplace games that sought to address three questions which were pertinent for modern, distributed workplaces:

1. How and what are we doing?

2. What is my contribution?

3. Are we having fun yet?

The execution of this methodology spanned several years and consisted of performing the following steps:

1. Developing a generalized set of eight heuristics which can be used in the development of workplace games.

2. Developing a system that uses these heuristics (Taskville).

3. Evaluating the system through two pilot studies consisting of 16 and 12 participants respectively in order to test the efficacy of raising awareness in the workplace using gamification principles.

4. Iterating on the design of Taskville by incorporating feedback from the pilot studies.

5. Conducting longitudinal evaluations of Taskville to further validate Taskville as an awareness tool. The goal of these studies, along with the pilot studies, was to seek answers for the three questions above by examining the effectiveness of the heuristics, Taskville's ability to raise awareness, and Taskville's ability to promote coordination and community building.

The heuristics were influenced by prior work examining what factors lead to successful games (Pinelle et al., 2008). These heuristics were divided into two categories with the first category (Interaction and Engagement) focusing on providing a pain-free,

engaging user experience while the second category (Social Awareness and Cohesion) focused on promoting community and raising awareness. These heuristics were as follows:

Interaction and Engagement

1) Allow for simple and ubiquitous interaction

2) Provide responsive feedback

3) Be lightly competitive

4) Have simple rules

Social Awareness and Cohesion

5) Display the game in a semi-public area

6) Promote community-building

7) Be visually appealing

8) Respect the privacy of your users

The goal of these heuristics were to provide a good balance of user engagement and fun while not being overly disruptive to the day-to-day activities that occur in the workplace. Overall, qualitative data from the pilot studies and longitudinal evaluations of Taskville revealed that these heuristics were quite successful in developing a game for the workplace centered on raising awareness. Very high marks on a system usability scale combined with the warm reception of the visuals, competitive gameplay elements, and other gameplay mechanics (e.g. achievements) show that these heuristics are successful in developing workplace games focused on raising awareness. It also provides affirmation that gamification can be used effectively in workplace contexts to enhance

engagement and to encourage continued use of the system in a fun manner. In this way, the question of *Are we having fun yet?* was successfully addressed through Taskville.

The pilot studies demonstrated that workplace awareness is an issue worth exploring through the use of digital workplace interventions. A number of discrepancies were found when comparing participants' data from Taskville compared to their responses when asked about their workplace activity on a survey. On the survey, participants tended to underestimate the number of tasks that they completed over a course of a day compared to the Taskville data. Additionally, participants overestimated how long it took them to complete a task on average. This reveals that an individual's perception of workplace activity is, at best, inconsistent and that systems like Taskville can be useful.

Participants from the pilot studies also gave feedback that further illustrated the challenges of developing games for the workplace. Privacy was a looming concern as participants were concerned that Taskville would be used as an evaluation tool rather than as an awareness tool that empowers the worker. This can be attributed to Taskville being highly visible due to it being deployed on semi-public situated displays thus making it easier for managers to continually monitor it. Overwhelming concern over this issue resulted in a new heuristic being added which resulted in the addition of the tag cloud feature to Taskville. Collaborative tasks, in the form of multi-tile buildings, were added to the system to better reflect the collaborative nature of the workplace and its importance. The pilot studies also showed that some individuals had issues with the Taskville's exclusive focus on work activity. While Taskville succeeds in making an individual aware of what they are working on, it also makes them acutely aware of how

much of their lives are spent on work which can be distressing for some. Therefore, features were added to support the concept of maintaining a healthy work-life balance.

After these changes were made, and spurred on by the positive feedback and results from the pilot studies, two longitudinal studies were conducted to further examine Taskville and its efficacy as a workplace awareness tool. These studies consisted of 37 and 11 participants respectively and highlighted some interesting results that show that workplace games can be effective in raising awareness. Qualitative feedback from surveys administered at the conclusion of the studies reveals that Taskville is successful as an individual awareness tool (4.19 out of 5) and as a motivational tool to complete work (4.06 out of 5). While participants did not believe Taskville was as successful as a group awareness tool, interesting correlations of activity existed between groups. This indicates that participants tended to submit tasks when they were *aware* that other participants were submitting tasks. This awareness could stem from notifications from the game or from viewing the visualization. Regardless, it shows that Taskville is working to some degree as a group awareness tool despite participants not believing so. This merits additional investigation in future, but overall shows that Taskville was successful in addressing the questions of *How and what are we doing?* and *What is my contribution?*

In addition to Taskville, this thesis also explored how such a system can be evaluated if one wanted to examine its effects on productivity, affective states, etc. Specifically, variants on the traditional experience sampling method were determined to be the best way to measure these variables. However, there are currently not many active tools that aid the researcher in conducting these types of studies which require a high level of researcher involvement. This is due to surveys having to be repeatedly sent out at

99

different points of time across the length of the study. Therefore, Studious was introduced which was designed to reduce this tedium. Studious is a Ruby on Rails plugin/gem that provides functionality to the researcher to administer ESM surveys online. Additionally, Studious automates the process of reminding the participant to complete these surveys based on time parameters given by the researcher. Potentially significant cost and time savings can be had for using this approach.

Overall the studies revealed that Taskville is successful as an awareness tool and demonstrates the merit of using a gamification approach towards raising awareness in the workplace. Overwhelmingly, participants found that Taskville was easy and fun to use with many of them pointing out the game-like competitive elements as being the main contributing factor. Like a real city, Taskville will continue to grow and adapt over time thanks to the generous feedback given by its numerous participants, or citizens as they are called in the game. This will only serve to make Taskville better and it is therefore apt to end on a quote from Plato: "*This city is what it is because our citizens are what they are.*"

REFERENCES

Amabile, T. M., Barsade, S. G., Mueller, J. S., & Staw, B. M. (2005). Affect and Creativity at Work. *Administrative Science Quarterly*, *50*(3), 367–403. doi:10.2189/asqu.2005.50.3.367

Bardram, J. E., & Hansen, T. R. (2010). Context-Based Workplace Awareness. *Computer Supported Cooperative Work (CSCW)*, *19*(2), 105–138. doi:10.1007/s10606-010-9110-2

Bartholomew, L. K., Gold, R. S., Parcel, G. S., Czyzewski, D. I., Sockrider, M. M., Fernandez, M., … Swank, P. (2000). Watch, Discover, Think, and Act: evaluation of computer-assisted instruction to improve asthma self-management in inner-city children. *Patient Education and Counseling*, *39*(2-3), 269–280. doi:16/S0738-3991(99)00046-4

Begole, J. "Bo," Tang, J. C., Smith, R. B., & Yankelovich, N. (2002). Work rhythms: analyzing visualizations of awareness histories of distributed groups. In *Proceedings of the 2002 ACM Conference on Computer Supported Cooperative Work* (pp. 334–343). New York, NY, USA: ACM. doi:10.1145/587078.587125

Bergstrom, T., & Karahalios, K. (2007). Conversation Clock: Visualizing audio patterns in co-located groups. In *Proceedings of the 40th Annual Hawaii International Conference on System Sciences* (p. 78–). Washington, DC, USA: IEEE Computer Society. doi:10.1109/HICSS.2007.151

Biehl, J. T., Czerwinski, M., Smith, G., & Robertson, G. G. (2007). FASTDash: a visual dashboard for fostering awareness in software teams. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1313–1322). New York, NY, USA: ACM. doi:10.1145/1240624.1240823

Biehl, J. T., Turner, T., van Melle, W., & Girgensohn, A. (2011). myUnity: a new platform to support communication in the modern workplace. In *Proceedings of the 19th ACM International Conference on Multimedia* (pp. 801–802). New York, NY, USA: ACM. doi:10.1145/2072298.2072465

Boehner, K., Gay, G., Sengers, P., Brooke, T., & Chen, X. (2004). Technologies for reflection. In *Ubiquitous Computing, in Reflective HCI: Towards a Critical Technical Practice, Workshop, CHI*.

Brief, A. P., & Weiss, H. M. (2002). ORGANIZATIONAL BEHAVIOR: Affect in the Workplace. *Annual Review of Psychology*, *53*(1), 279–307. doi:10.1146/annurev.psych.53.100901.135156

Brush, A. J. B., Meyers, B. R., Scott, J., & Venolia, G. (2009). Exploring awareness needs and information display preferences between coworkers. In *Proc. CHI* (pp. 2091–2094). Boston, MA, USA: ACM. Retrieved from

http://portal.acm.org.ezproxy1.lib.asu.edu/citation.cfm?id=1518701.1519018&coll=GUIDE&dl=GUIDE&CFID=83489342&CFTOKEN=95165210

Cao, X., Massimi, M., & Balakrishnan, R. (2008). Flashlight jigsaw: an exploratory study of an ad-hoc multi-player game on public displays. In *Proceedings of the 2008 ACM Conference on Computer Supported Cooperative Work* (pp. 77–86). New York, NY, USA: ACM. doi:10.1145/1460563.1460577

Carter, S., Mankoff, J., & Heer, J. (2007). Momento: support for situated ubicomp experimentation. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 125–134). New York, NY, USA: ACM. doi:10.1145/1240624.1240644

Chao, D. (2001). Doom as an interface for process management. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 152–157). Seattle, Washington, United States: ACM. doi:10.1145/365024.365078

Consolvo, S., Klasnja, P., McDonald, D. W., Avrahami, D., Froehlich, J., LeGrand, L., … Landay, J. A. (2008). Flowers or a robot army?: encouraging awareness & activity with personal, mobile displays. In *Proceedings of the 10th International Conference on Ubiquitous Computing* (pp. 54–63). New York, NY, USA: ACM. doi:10.1145/1409635.1409644

Crawford, C. (1982). *The art of computer game design*. Osborne/McGraw-Hill.

Csikszentmihalyi, M., & Larson, R. (1987). Validity and reliability of the experience-sampling method. *The Journal of Nervous and Mental Disease*, *175*(9), 526.

Dex, S., & Bond, S. (2005). Measuring work-life balance and its covariates. *Work, Employment & Society*, *19*(3), 627–637. doi:10.1177/0950017005055676

Dey, A. K., & de Guzman, E. (2006). From awareness to connectedness: the design and deployment of presence displays. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 899–908). New York, NY, USA: ACM. doi:10.1145/1124772.1124905

Dourish, P., & Bellotti, V. (1992). Awareness and coordination in shared workspaces. In *Proceedings of the 1992 ACM Conference on Computer Supported Cooperative Work* (pp. 107–114). New York, NY, USA: ACM. doi:10.1145/143457.143468

Dunham, R. B., & Herman, J. B. (1975). Development of a female Faces Scale for measuring job satisfaction. *Journal of Applied Psychology*, *60*(5), 629–631. doi:10.1037/0021-9010.60.5.629

Ellis, J. B., Luther, K., Bessiere, K., & Kellogg, W. A. (2008). Games for virtual team building. In *Proceedings of the 7th ACM conference on Designing Interactive*

Systems (pp. 295–304). New York, NY, USA: ACM. doi:10.1145/1394445.1394477

Finke, M., Tang, A., Leung, R., & Blackstock, M. (2008). Lessons learned: game design for large public displays. In *Proceedings of the 3rd International Conference on Digital Interactive Media in Entertainment and Arts* (pp. 26–33). New York, NY, USA: ACM. doi:10.1145/1413634.1413644

Flixel. (n.d.). Retrieved October 29, 2013, from http://www.flixel.org/

Fogarty, J., Lai, J., & Christensen, J. (2004). Presence versus availability: the design and evaluation of a context-aware communication client. *International Journal of Human-Computer Studies*, *61*(3), 299–317. doi:10.1016/j.ijhcs.2003.12.016

Froehlich, J., Chen, M. Y., Consolvo, S., Harrison, B., & Landay, J. A. (2007). MyExperience: a system for *in situ* tracing and capturing of user feedback on mobile phones. In *Proceedings of the 5th International Conference on Mobile Systems, Applications and Services* (pp. 57–70). New York, NY, USA: ACM. doi:10.1145/1247660.1247670

Froehlich, J., & Dourish, P. (2004). Unifying Artifacts and Activities in a Visual Tool for Distributed Software Development Teams. In *Proceedings of the 26th International Conference on Software Engineering* (pp. 387–396). Washington, DC, USA: IEEE Computer Society.

Geister, S., Konradt, U., & Hertel, G. (2006). Effects of Process Feedback on Motivation, Satisfaction, and Performance in Virtual Teams. *Small Group Research*, *37*(5), 459–489. doi:10.1177/1046496406292337

Goldberg, A., & Flegal, R. (1982). ACM President's Letter: Pixel Art. *Communications of the ACM*, *25*(12), 861–862. doi:10.1145/358728.358731

Greenberg, S., & Rounding, M. (2001). The notification collage: posting information to public and personal displays. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 514–521). New York, NY, USA: ACM. doi:10.1145/365024.365339

Guest, D. E. (2002). Perspectives on the Study of Work-life Balance. *Social Science Information*, *41*(2), 255–279. doi:10.1177/0539018402041002005

Gutwin, C., & Greenberg, S. (1996). Workspace awareness for groupware. In *Conference Companion on Human Factors in Computing Systems* (pp. 208–209). New York, NY, USA: ACM. doi:10.1145/257089.257284

Handel, M., & Herbsleb, J. D. (2002). What is chat doing in the workplace? In *Proceedings of the 2002 ACM Conference on Computer Supported Cooperative Work* (pp. 1–10). New York, NY, USA: ACM. doi:10.1145/587078.587080

Hardill, I., & Green, A. (2003). Remote working—altering the spatial contours of work and home in the new economy. *New Technology, Work and Employment*, *18*(3), 212–222. doi:10.1111/1468-005X.00122

Hinds, P. J., & Bailey, D. E. (2003). Out of sight, out of sync: Understanding conflict in distributed teams. *Organization Science*, *14*(6), 615–632.

Hoffman, C. C., Nathan, B. R., & Holden, L. M. (1991). A Comparison of Validation Criteria: Objective Versus Subjective Performance Measures and Self- Versus Supervisor Ratings. *Personnel Psychology*, *44*(3), 601.

Holmquist, L. E., Falk, J., & Wigström, J. (1999). Supporting group collaboration with interpersonal awareness devices. *Personal Technologies*, *3*(1-2), 13–21. doi:10.1007/BF01305316

Intille, S. S., Tapia, E. M., Rondoni, J., Beaudin, J., Kukla, C., Agarwal, S., … Larson, K. (2003). Tools for Studying Behavior and Technology in Natural Settings. In A. K. Dey, A. Schmidt, & J. F. McCarthy (Eds.), *UbiComp 2003: Ubiquitous Computing* (pp. 157–174). Springer Berlin Heidelberg.

James, K., Brodersen, M., & Eisenberg, J. (2004). Workplace Affect and Workplace Creativity: A Review and Preliminary Model. *Human Performance*, *17*(2), 169–194. doi:10.1207/s15327043hup1702_3

Kahneman, D., Krueger, A. B., Schkade, D. A., Schwarz, N., & Stone, A. A. (2004). A Survey Method for Characterizing Daily Life Experience: The Day Reconstruction Method. *Science*, *306*(5702), 1776–1780. doi:10.1126/science.1103572

Koster, R., & Wright, W. (2005). *A theory of fun for game design*. Paraglyph press Indianapolis.

Kraut, R. E., Fussell, S. R., Brennan, S. E., & Siegel, J. (2002). Understanding effects of proximity on collaboration: Implications for technologies to support remote collaborative work. *Distributed work*, 137–162.

Ledford Jr., G. E. (1999). Comment: Happiness and Productivity Revisited. *Journal of Organizational Behavior*, *20*(1), 25–30.

Lee, M. K., & Takayama, L. (2011). "Now, i have a body": uses and social norms for mobile remote presence in the workplace. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 33–42). New York, NY, USA: ACM. doi:10.1145/1978942.1978950

Lieberman, D. A. (2001). Management of chronic pediatric diseases with interactive health games: Theory and research findings. *The Journal of Ambulatory Care Management*, *24*(1), 26.

Mabe, P. A., & West, S. G. (1982). Validity of self-evaluation of ability: A review and meta-analysis. *Journal of Applied Psychology*, *67*(3), 280–296. doi:10.1037/0021-9010.67.3.280

McCarthy, J. F., Congleton, B., & Harper, F. M. (2008). The context, content & community collage: sharing personal digital media in the physical workplace. In *Proceedings of the 2008 ACM Conference on Computer Supported Cooperative Work* (pp. 97–106). New York, NY, USA: ACM. doi:10.1145/1460563.1460580

Mitchell, W., Inouye, A., & Blumenthal, M. (2003). *Beyond Productivity: Information Technology, Innovation, and Creativity*. Washington, DC: National Academies Press.

Nardi, B. A., & Whittaker, S. (2002). The place of face-to-face communication in distributed work. *Distributed work*, 83–110.

Nikkila, S., Byrne, D., Sundaram, H., Kelliher, A., & Linn, S. (2013). Taskville: visualizing tasks and raising awareness in the workplace. In *CHI '13 Extended Abstracts on Human Factors in Computing Systems* (pp. 151–156). New York, NY, USA: ACM. doi:10.1145/2468356.2468384

Nikkila, S., Linn, S., Sundaram, H., & Kelliher, A. (2011). Playing in Taskville: Designing a Social Game for the Workplace. In *CHI 2011 Workshop on Gamification: Using Game Design Elements in Non-Game Contexts*.

Nikkila, S., Patel, G., Sundaram, H., Kelliher, A., & Sabharwal, A. (2012). Wind runners: designing a game to encourage medical adherence for children with asthma. In *CHI '12 Extended Abstracts on Human Factors in Computing Systems* (pp. 2411–2416). New York, NY, USA: ACM. doi:10.1145/2212776.2223811

Oravec, J. A. (2002). Constructive approaches to internet recreation in the workplace. *Communications of the ACM*, *45*(1), 60–63. doi:10.1145/502269.502298

Papastergiou, M. (2009). Exploring the potential of computer and video games for health and physical education: A literature review. *Computers & Education*, *53*(3), 603–622.

Pearce, C. (2006). Productive Play: Game Culture From the Bottom Up. *Games and Culture*, *1*(1), 17–24. doi:10.1177/1555412005281418

Pinelle, D., Wong, N., & Stach, T. (2008). Heuristic evaluation for games: usability principles for video game design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1453–1462). New York, NY, USA: ACM. doi:10.1145/1357054.1357282

Salen, K., & Zimmerman, E. (2003). *Rules of play: Game design fundamentals*. MIT Press.

Scollon, C. N., Kim-Prieto, C., & Diener, E. (2003). Experience Sampling: Promises and Pitfalls, Strengths and Weaknesses. *Journal of Happiness Studies*, *4*(1), 5–34. doi:10.1023/A:1023605205115

Sellen, A., Eardley, R., Izadi, S., & Harper, R. (2006). The whereabouts clock: early testing of a situated awareness device. In *CHI '06 Extended Abstracts on Human Factors in Computing Systems* (pp. 1307–1312). New York, NY, USA: ACM. doi:10.1145/1125451.1125694

Shastri, D., Fujiki, Y., Buffington, R., Tsiamyrtzis, P., & Pavlidis, I. (2010). O job can you return my mojo: improving human engagement and enjoyment in routine activities. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 2491–2498). New York, NY, USA: ACM. doi:10.1145/1753326.1753703

Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Clinical Psychology*, *4*(1), 1.

Sniderman, S. (1999). Unwritten Rules. *The Life of Games*, *1*(1). Retrieved from http://www.gamepuzzles.com/tlog/tlog1.htm

Sparks, K., Cooper, C., Fried, Y., & Shirom, A. (1997). The effects of hours of work on health: A meta-analytic review. *Journal of Occupational and Organizational Psychology*, *70*(4), 391–408. doi:10.1111/j.2044-8325.1997.tb00656.x

Sturges, J., & Guest, D. (2004). Working to live or living to work? Work/life balance early in the career. *Human Resource Management Journal*, *14*(4), 5–20. doi:10.1111/j.1748-8583.2004.tb00130.x

Terrell, G. B., & McCrickard, D. S. (2006). Enlightening a co-located community with a semi-public notification system. In *Proceedings of the 2006 Conference on Computer Supported Cooperative Work* (pp. 21–24). New York, NY, USA: ACM. doi:10.1145/1180875.1180879

Thompson, E. R. (2007). Development and Validation of an Internationally Reliable Short-Form of the Positive and Negative Affect Schedule (PANAS). *Journal of Cross-Cultural Psychology*, *38*(2), 227–242. doi:10.1177/0022022106297301

US Census Bureau. (2013, May). Computer and Internet Use in the United States: Population Characteristics. Retrieved from http://www.census.gov/prod/2013pubs/p20-569.pdf

Viégas, F. B., Golder, S., & Donath, J. (2006). Visualizing email content: portraying relationships from conversational histories. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 979–988). New York, NY, USA: ACM. doi:10.1145/1124772.1124919

Want, R., & Hopper, A. (1992). Active badges and personal interactive computing objects. *IEEE Transactions on Consumer Electronics*, *38*(1), 10–20. doi:10.1109/30.125076

Ward, J. (2013, October 28). I Am Robot Boss. *Popular Science*. Retrieved October 31, 2013, from http://www.popsci.com/article/technology/i-am-robot-boss

Watson, D., & Clark, L. A. (1994). The PANAS-X: Manual for the Positive and Negative Affect Schedule-Expanded Form. *Manual for the positive and negative affect schedule–expanded form*. Retrieved from http://ir.uiowa.edu/cgi/viewcontent.cgi?article=1011&context=psychology_pubs

Watson, David, Clark, L. A., & Tellegen, A. (1988). Development and Validation of Brief Measures of Positive and Negative Affect: The PANAS Scales. *Journal of Personality and Social Psychology*, *54*(6), 1063–1070. doi:10.1037/0022-3514.54.6.1063

Wilson, S., Galliers, J., & Fone, J. (2006). Not all sharing is equal: the impact of a large display on small group collaborative work. In *Proceedings of the 2006 Conference on Computer Supported Cooperative Work* (pp. 25–28). New York, NY, USA: ACM. doi:10.1145/1180875.1180880

APPENDIX A

SURVEYS FROM THE FIRST STUDIES

Taskville Pre-Study Questionnaire

Thank you for participating in this user study. You are helping in the development of a fun, interactive visualization that facilitates individual, group, and organizational awareness of work related tasks being performed. This survey should take approximately 16 minutes to complete.

Demographics
1. What is your gender?
    a. Male
    b. Female

2. What is your occupation?

3. What year were you born?

Games
4. Do you enjoy playing competitive games (board games, videogames, card games, etc.)?
    a. Yes
    b. No

5. Have you ever played a videogame in the past?
    a. Yes
    b. No

6. Would you say that you play videogames on a regular basis? A regular basis implies that you play videogames for at least one hour per week.
    a. Yes
    b. No

7. If you answered "Yes" to the previous question, about how many hours do you spend playing videogames per week?
    a. 1 – 2 hours
    b. 3 – 4 hours
    c. 5 – 6 hours
    d. 7 – 8 hours
    e. Greater than 9 hours

8. If you play videogames regularly, what type of videogames do you enjoy playing? Check all that apply.
    a. Strategy games (e.g., Civilization, StarCraft)
    b. Life simulation games (e.g., Sim City, The Sims, Spore)

c. Role playing games (e.g., Mass Effect, Final Fantasy, Baldur's Gate)

d. Platforming games (e.g., Mario Bros., Sonic)

e. First person action games (e.g., Halo, Call of Duty, Doom)

f. Other

Communication

Unless instructed otherwise, for all of the questions in this section, please check all that apply.

9. How do you communicate with other individuals that belong to your group?
    a. Individually in person
    b. By phone
    c. Using Skype
    d. Through e-mail
    e. Through instant messaging
    f. Using a social networking site (e.g., Twitter, Facebook)
    g. Group meetings
    h. Other. Please specify:

    _____

10. Approximately how many times do you meet with other members in your group for work related matters in a given week?
    a. 0
    b. 1
    c. 2
    d. 3
    e. 4
    f. 5
    g. 6
    h. Greater than 6. Please specify an approximate number:

    _____

11. Approximately how many people in your group do you meet with per week for work related matters on what you would consider a regular basis?
    a. 0
    b. 1
    c. 2
    d. 3
    e. 4
    f. 5
    g. 6

h. Greater than 6. Please specify an approximate number:
  _____

12. How do you communicate with other individuals who are not a member of your group but are still affiliated with AME? For example, if you work for Reflective Living in AME, how do you communicate with individuals in the Rehabilitation group in AME?
   a. Individually in person
   b. By phone
   c. Using Skype
   d. Through e-mail
   e. Through instant messaging
   f. Using a social networking site (e.g., Twitter, Facebook)
   g. Group meetings
   h. Other. Please specify:

   _____

13. Approximately how many times do you meet with individuals not in your group but affiliated with AME for work related matters in a given week?
   a. 0
   b. 1
   c. 2
   d. 3
   e. 4
   f. 5
   g. 6
   h. Greater than 6. Please specify an approximate number:
     _____

14. Approximately how many individuals not in your group but affiliated with AME do you meet with per week for work related matters?
   a. 0
   b. 1
   c. 2
   d. 3
   e. 4
   f. 5
   g. 6
   h. Greater than 6. Please specify an approximate number:
     _____

Work Habits

Unless instructed otherwise, for all of the questions in this section, please check all that apply. For the purpose of this survey, a task can be any activity that you partake in that you view as productive and is focused on work. For example, reading a research paper can be considered a task as well as calibrating software for a demonstration.

15. Do you use any task management tools? If you answer "No" to this question, then please skip to question #20.
    a. Yes
    b. No

16. What task management tools do you use regularly?
    a. Sticky notes
    b. Notebook
    c. Whiteboard
    d. Physical calendar
    e. Electronic calendar (e.g., Google, Outlook)
    f. Remember the Milk
    g. Other. Please specify:

    _____

17. On average, how often do you update your task management tool? Please select only one.
    a. More than once per day
    b. Once per day
    c. More than once per week
    d. Once per week
    e. More than once per month
    f. Once per month
    g. Less than once per month

18. If you use a task management tool, do you use the sharing features (if applicable) to keep your colleagues "in the know" about the tasks that you are working on? If you answer "No" to this question, then please skip to question #20.
    a. Yes
    b. No

19. How many times per week do you use the sharing features of your task management tool to check on what tasks others are working on?
    a. 0
    b. 1

c. 2

d. 3

e. 4

f. 5

g. 6

h. Greater than 6. Please specify an approximate number:

_____

20. Which of the following work related tasks do you consider to be repetitive?

    a. Reading research papers, journals, grants, etc.

    b. Writing research papers, journals, grants, etc.

    c. Software development/configuration/calibration

    d. Hardware development/configuration/calibration

    e. IT work

    f. User studies

    g. Meetings

    h. Class work

    i. Other. Please specify any other tasks that you consider to be repetitive:

    _____

21. Which of the following work related tasks do you consider to be boring?

    a. Reading research papers, journals, grants, etc.

    b. Writing research papers, journals, grants, etc.

    c. Software development, configuration, and/or calibration

    d. Hardware development, configuration, and/or calibration

    e. IT work

    f. User studies

    g. Meetings

    h. Class work

    i. Other. Please specify any other tasks that you consider to be repetitive:

    _____

22. On average, how many work related tasks do you complete in a week?

    a. 0

    b. 1 – 3

    c. 4 – 6

    d. 7 – 9

    e. 10 - 12

    f. Greater than 12

23. What percentage of these tasks are short tasks that take less than 2 hours to complete?

113

a. 0 – 10%
b. 11 – 20%
c. 21 – 30%
d. 31 – 40%
e. 41 – 50%
f. 51 – 60%
g. 61 – 70%
h. 71 – 80%
i. 81 – 90%
j. 91 – 100%

24. How many hours per day do you spend on work related tasks?
a. Less than 1 hour
b. 1 – 2 hours
c. 3 – 4 hours
d. 5 – 6 hours
e. 7 – 8 hours
f. 9 – 10 hours
g. 11 – 12 hours
h. Greater than 12 hours

25. During what times of the day do you feel that you are the most productive at work?
a. 9:00 AM – 12:00 PM
b. 12:00 PM – 3:00 PM
c. 3:00 PM – 6:00 PM
d. 6:00 PM – 9:00 PM
e. 9:00 PM – 12:00 AM
f. 12:00 AM – 3:00 AM
g. 3:00 AM – 6:00 AM
h. 6:00 AM – 9:00 AM

26. On which day(s) do you feel that you have the largest number of work related tasks to complete?
a. Sunday
b. Monday
c. Tuesday
d. Wednesday
e. Thursday
f. Friday
g. Saturday

27. Do you have any days in the week that you take off regularly from work? If so, what days?
    a. Sunday
    b. Monday
    c. Tuesday
    d. Wednesday
    e. Thursday
    f. Friday
    g. Saturday

Please rate how much you agree with the following statements with 1 indicating that you strongly disagree and 7 indicating that you strongly agree.

28. I am aware of the number of tasks that I complete every day.
    1   2   3   4   5   6   7

29. I am aware of the number of tasks that my colleagues in my group work on every day.
    1   2   3   4   5   6   7

30. I am aware of the number of tasks that my AME colleagues in other groups are working on every day.
    1   2   3   4   5   6   7

31. I enjoy working on work related tasks.
    1   2   3   4   5   6   7

32. I am motivated when working on work related tasks.
    1   2   3   4   5   6   7

33. The task management tools that I use allow me to easily see what tasks others in my group are currently working on.
    1   2   3   4   5   6   7

Taskville Post-Study Questionnaire

1. On average, how many work related tasks do you complete in a week?
    a. 0
    b. 1 – 3
    c. 4 – 6
    d. 7 – 9
    e. 10 - 12
    f. Greater than 12

2. What percentage of these tasks are short tasks that take less than 2 hours to complete?
    a. 0 – 10%
    b. 11 – 20%
    c. 21 – 30%
    d. 31 – 40%
    e. 41 – 50%
    f. 51 – 60%
    g. 61 – 70%
    h. 71 – 80%
    i. 81 – 90%
    j. 91 – 100%

3. How many hours per day do you spend on work related tasks?
    a. Less than 1 hour
    b. 1 – 2 hours
    c. 3 – 4 hours
    d. 5 – 6 hours
    e. 7 – 8 hours
    f. 9 – 10 hours
    g. 11 – 12 hours
    h. Greater than 12 hours

4. During what times of the day do you feel that you are the most productive at work?
    a. 9:00 AM – 12:00 PM
    b. 12:00 PM – 3:00 PM
    c. 3:00 PM – 6:00 PM
    d. 6:00 PM – 9:00 PM
    e. 9:00 PM – 12:00 AM
    f. 12:00 AM – 3:00 AM
    g. 3:00 AM – 6:00 AM
    h. 6:00 AM – 9:00 AM

5. On which day(s) do you feel that you have the largest number of work related tasks to complete?
    a. Sunday
    b. Monday
    c. Tuesday
    d. Wednesday
    e. Thursday
    f. Friday

g. Saturday

6. Do you have any days in the week that you take off regularly from work? If so, what
   days?
      a. Sunday
      b. Monday
      c. Tuesday
      d. Wednesday
      e. Thursday
      f. Friday
      g. Saturday

Please rate how much you agree with the following statements with 1 indicating that you
strongly disagree and 7 indicating that you strongly agree.

7. I am aware of the number of tasks that I complete every day.
   1   2   3   4   5   6   7

8. I am aware of the number of tasks that my colleagues in my group work on every day.
   1   2   3   4   5   6   7

9. I am aware of the number of tasks that my AME colleagues in other groups are working
   on every day.
   1   2   3   4   5   6   7

10. I enjoy working on work related tasks.
   1   2   3   4   5   6   7

11. I am motivated when working on work related tasks.
   1   2   3   4   5   6   7

12. The task management tools that I use allow me to easily see what tasks others in my
   group are currently working on.
   1   2   3   4   5   6   7

APPENDIX B

SURVEYS FROM THE SECOND STUDIES

Taskville Pre-Study Questionnaire

Invitation

Please enter the invitation key that you used to register with the Taskville website:

Communication and Work Activity

For the purposes of this study, a task is any work-related activity that you spend some amount of time on. You do not have to "finish" the activity to have it count as a task. For instance, if you are writing a design document, write one section in 3 hours, and move on to another activity, that counts as a task that took 3 hours to complete for the purposes of this study.

1. How do you communicate with other individuals at work (co-workers in the office, business associates, customers, etc.)? Please check all that apply.
    a. Individually in person
    b. By phone
    c. Using Skype
    d. Through e-mail
    e. Through instant messaging
    f. Using a social networking site (e.g., Twitter, Facebook)
    g. Group meetings
    h. Other. Please specify: _____

2. What task management tools do you use regularly? Please check all that apply.
    a. I do not use any task management tools.
    b. Sticky notes
    c. Notebook
    d. Whiteboard
    e. Physical calendar
    f. Electronic calendar (e.g., Google, Outlook)
    g. Web or mobile applications (e.g., Remember the Milk)
    h. Enterprise and productivity software (e.g., Microsoft Project, IBM Rational Software)
    i. Other. Please specify: _____

3. On average, how often do you update your task management tool? **Please select only one.**
    a. More than once per day
    b. Once per day
    c. More than once per week
    d. Once per week
    e. More than once per month

   f. Once per month

   g. Less than once per month

4. If you use a task management tool, do you use the sharing features (if applicable) to help coordinate work activities between you and your colleagues?

   a. Yes

   b. No

5. If you use a task management tool, do you use the sharing features (if applicable) to see what other colleagues are working on?

   a. Yes

   b. No

6. On which day(s) do you feel that you have the largest number of work related tasks to complete? Please check all that apply.

   a. Sunday

   b. Monday

   c. Tuesday

   d. Wednesday

   e. Thursday

   f. Friday

   g. Saturday

7. During what times of the day do you feel that you are the most productive at work? Please check all that apply.

   a. 9:00 AM – 12:00 PM

   b. 12:00 PM – 3:00 PM

   c. 3:00 PM – 6:00 PM

   d. 6:00 PM – 9:00 PM

   e. 9:00 PM – 12:00 AM

   f. 12:00 AM – 3:00 AM

   g. 3:00 AM – 6:00 AM

   h. 6:00 AM – 9:00 AM

8. On average, how long do you spend on each task in the workplace?

   a. Very little time (less than 1 hour per task)

   b. Not too much time (less than 2 hours per task)

   c. An average amount of time (about 3 to 5 hours per task)

   d. A lot of time (more than 5 hours per task)

9. On average, how many tasks do you think you complete per day?

a. 0

b. 1 – 3

c. 4 – 6

d. 7 – 9

e. 10 or more

Likert Scale Questions

Please rate how much you agree with the following statements with 1 indicating that you strongly disagree and 7 indicating that you strongly agree.

10. I am proficient in the use of computers and other computing technology.

    1   2   3   4   5   6   7

11. I am aware of the number of **work related** tasks that *I* complete every day.

    1   2   3   4   5   6   7

12. I am aware of the number of **personal tasks** that *I* complete every day.

    1   2   3   4   5   6   7

13. I am aware of the number of tasks that **my colleagues** in *my* group work on every day.

    1   2   3   4   5   6   7

14. I am aware of the number of tasks that **my colleagues** in *other* groups within my organization are working on every day.

    1   2   3   4   5   6   7

15. The task management tools that I use **do not** allow me to easily see what tasks others in my group are currently working on.

    1   2   3   4   5   6   7

16. I feel that I am very productive on a daily basis during the work week.

    1   2   3   4   5   6   7

Workplace Mood

Please complete the following questions which ask you about your mood while at work.

Thinking about yourself and how you normally feel while at work, to what extent, at work, do you generally feel (1 indicates "never" and 5 indicates "always":

1. Upset

    1   2   3   4   5

2. Hostile
   1   2   3   4   5

3. Alert
   1   2   3   4   5

4. Ashamed
   1   2   3   4   5

5. Inspired
   1   2   3   4   5

6. Nervous
   1   2   3   4   5

7. Determined
   1   2   3   4   5

8. Attentive
   1   2   3   4   5

9. Afraid
   1   2   3   4   5

10. Active
   1   2   3   4   5

Demographics

1. What is your gender?
   a. Male
   b. Female

2. What is your occupation?

3. What is your age?

4. Which of the following mobile devices do you own? Check all that apply.
   a. Smartphone (Android, iPhone, Windows phone, etc.)
   b. Tablet (Android Tablet, iPad, Kindle Fire, Nook Tablet, etc.)

      c.   Mp3 player (Zune, iPod, Walkman, etc.)

      d.   Portable gaming device (Nintendo DS, 3DS, Vita, PSP, etc.)

      e.   Other. Please specify: _____

Taskville Mid-Study Questionnaire

Invitation Key

1. Please enter the invitation key that you used to register with the Taskville website:

Workplace Activity

2. On which day(s) do you feel that you have the largest number of work related tasks to complete? Please check all that apply.
   a. Sunday
   b. Monday
   c. Tuesday
   d. Wednesday
   e. Thursday
   f. Friday
   g. Saturday

3. During what times of the day do you feel that you are the most productive at work? Please check all that apply.
   a. 9:00 AM – 12:00 PM
   b. 12:00 PM – 3:00 PM
   c. 3:00 PM – 6:00 PM
   d. 6:00 PM – 9:00 PM
   e. 9:00 PM – 12:00 AM
   f. 12:00 AM – 3:00 AM
   g. 3:00 AM – 6:00 AM
   h. 6:00 AM – 9:00 AM

4. On average, how long do you spend on each task in the workplace?
   a. Very little time (less than 1 hour per task)
   b. Not too much time (less than 2 hours per task)
   c. An average amount of time (about 3 to 5 hours per task)
   d. A lot of time (more than 5 hours per task)

5. On average, how many tasks do you think you complete per day?
   a. 0
   b. 1 – 3

      c.   4 – 6
      d.   7 – 9
      e.   10 or more

Workplace Mood

Please complete the following questions which ask you about your mood while at work.

Thinking about yourself and how you normally feel while at work, to what extent, at work, do you generally feel (1 indicates "never" and 5 indicates "always"):

1. Upset

    1   2   3   4   5

2. Hostile

    1   2   3   4   5

3. Alert

    1   2   3   4   5

4. Ashamed

    1   2   3   4   5

5. Inspired

    1   2   3   4   5

6. Nervous

    1   2   3   4   5

7. Determined

    1   2   3   4   5

8. Attentive

    1   2   3   4   5

9. Afraid

    1   2   3   4   5

10. Active

    1   2   3   4   5

Taskville Post-Study Questionnaire (Usability Survey)

Your responses for this survey are completely anonymous. The researchers **will not** be able to associate your identify with the responses that are given in this survey. This survey should take about 10 minutes to complete.

Please rate how much you agree with the following statements with 1 indicating that you strongly disagree and 5 indicating that you strongly agree. The Taskville visualization refers to the large visualization at the top of the Taskville web page which shows the cities and buildings when you log in.

1. I think that I would like to use Taskville frequently.
   1   2   3   4   5

2. I found Taskville to be unnecessarily complex.
   1   2   3   4   5

3. I thought Taskville was easy to use.
   1   2   3   4   5

4. I think that I would need the support of a technical person to be able to use Taskville.
   1   2   3   4   5

5. I found the various functions in Taskville were well integrated.
   1   2   3   4   5

6. I thought there was too much inconsistency in Taskville.
   1   2   3   4   5

7. I would imagine that most people would learn to use Taskville very quickly.
   1   2   3   4   5

8. I found Taskville to be very cumbersome to use.
   1   2   3   4   5

9. I felt very confident using Taskville.
   1   2   3   4   5

10. I needed to learn a lot of things before I could get going with Taskville.
   1   2   3   4   5

11. Taskville was fun to use.
   1   2   3   4   5

12. The use of cities and buildings as a metaphor for completed tasks made sense and resonated with me.

    1   2   3   4   5

13. I was able to easily identify which buildings belonged to me when viewing the Taskville visualization.

    1   2   3   4   5

14. I was able to easily identify which buildings belonged to other players when viewing the Taskville visualization.

    1   2   3   4   5

15. I was able to easily identify which buildings belonged to a particular city when viewing the Taskville visualization.

    1   2   3   4   5

16. I was able to easily see the number of tasks that I completed when looking at the Taskville visualization.

    1   2   3   4   5

17. I was able to ascertain what others working on when viewing the Taskville visualization.

    1   2   3   4   5

18. Using Taskville made me more aware of the amount of work that I do.

    1   2   3   4   5

19. Using Taskville made me more aware of what tasks I have been working on.

    1   2   3   4   5

20. Using Taskville gave me more motivation to complete my work.

    1   2   3   4   5

21. I feel that Taskville has made me more productive at work.

    1   2   3   4   5

22. Taskville has changed how I communicate with my work peers.

    1   2   3   4   5

23. I would be willing to use Taskville again in the future.

    1   2   3   4   5

24. I would recommend Taskville to others.
     1   2   3   4   5

25. (Free Response) What did you like about Taskville?

26. (Free Response) What did you dislike about Taskville?

27. (Free Response) Do you have any suggestions on how we can improve upon Taskville?

28. (Free Response) Any other comments about Taskville or the study?

Taskville Post-Study Questionnaire II

The responses for this survey will only be viewed by the principal researchers. The responses will not be shared with any 3rd party. For this survey, we would like you to reflect upon your past activity and mood while at work and answer the following questions. This survey should only take 4 minutes to complete.

1. Please enter the invitation key that you used to register with the Taskville website:

Workplace Activity

2. On which day(s) do you feel that you have the largest number of work related tasks to complete? Please check all that apply.
   a. Sunday
   b. Monday
   c. Tuesday
   d. Wednesday
   e. Thursday
   f. Friday
   g. Saturday

3. During what times of the day do you feel that you are the most productive at work? Please check all that apply.
   a. 9:00 AM – 12:00 PM
   b. 12:00 PM – 3:00 PM
   c. 3:00 PM – 6:00 PM
   d. 6:00 PM – 9:00 PM
   e. 9:00 PM – 12:00 AM
   f. 12:00 AM – 3:00 AM

g. 3:00 AM – 6:00 AM

h. 6:00 AM – 9:00 AM

4. On average, how long do you spend on each task in the workplace?
    a. Very little time (less than 1 hour per task)
    b. Not too much time (less than 2 hours per task)
    c. An average amount of time (about 3 to 5 hours per task)
    d. A lot of time (more than 5 hours per task)

5. On average, how many tasks do you think you complete per day?
    a. 0
    b. 1 – 3
    c. 4 – 6
    d. 7 – 9
    e. 10 or more

Workplace Mood

Please complete the following questions which ask you about your mood while at work.

Thinking about yourself and how you normally feel while at work, to what extent, at work, do you generally feel (1 indicates "never" and 5 indicates "always":

1. Upset

    1   2   3   4   5

2. Hostile

    1   2   3   4   5

3. Alert

    1   2   3   4   5

4. Ashamed

    1   2   3   4   5

5. Inspired

    1   2   3   4   5

6. Nervous

    1   2   3   4   5

7. Determined

    1   2   3   4   5

8. Attentive

    1   2   3   4   5

9. Afraid

    1   2   3   4   5

10. Active

    1   2   3   4   5

Taskville Work Goals Survey

Once again, thank you for participating in Taskville. Please complete the following survey which asks you to estimate how many work related tasks you are/will be working on and how many of those tasks you are planning to complete **this week**. This survey should take about 3 minutes to complete.

Recall that for the purposes of this study, a task is any work-related activity that you spend some amount of time on. You do not have to "finish" the activity to have it count as a task. For instance, if you are writing a design document and your goal is to write one section of it, then that counts as a task.

Once again, none of your responses will only be viewed by the principal investigators of this study. We will not give these results to any 3rd party.

Please remember the answers you gave for this survey! These answers will be referenced in a future survey.

1. Please enter the invitation key that you used to register with the Taskville website. We will be using this key to link this survey with another survey that you will be taking later.

    ----

2. How many total work-related tasks do you currently have? These tasks can range from those that need to be done today to those that need to be completed at some point in the coming months.

    ----

3. Out of those tasks, how many of them do you plan on finishing by the close of business on Friday (the end of the work week)?

Taskville Work Reflection Survey

On Monday, we asked you to complete a short survey asking you to estimate the total number of tasks that you needed to complete. The survey also asked you to estimate how many of those tasks you would be able to complete by the close of business today (Friday). This survey should take approximately 3 minutes to complete.

1. Please enter the invitation key that you used to register with the Taskville website. We will be using this key to link this survey with the survey that you took on Monday.

   ----

2. How productive do you think you were during the week? Please select a value from 1 to 7 with 1 indicating that you felt not very productive and 7 indicating that you felt very productive.

   1   2   3   4   5   6   7

3. In Monday's survey, you gave an estimate on the number of total tasks you currently have to do. Out of those tasks that you included in that number, how many of those were completed this week?

   ----

4. How many new work-related tasks came up this week?

   ----

5. How many of those new work-related tasks did you complete this week?

APPENDIX C

EXAMPLE STUDIOUS SURVEY

```
---
configuration:
  name: My Favorite Movies
  ttl: 10
  type: public

content:
  - section: What is one of your favorite movies?
    repeatable: true

    questions:
      - question: Type in a favorite movie here.
        type: text

  - section: Rate your favorite movies.
    repeatable: false
    new_page: true
    responds_to: 1

    questions:
      - question: If you were a movie critic, how many stars would you give
this movie?
        type: likert
        minrange: 1
        maxrange: 5
        stepsize: 1
        mintext: Unwatchable
        maxtext: Classic
        required: true

  - section: Final page.
    repeatable: false
    new_page: true

    questions:
      - instruction: Please fill out the entire survey. Should not take longer
than 5 minutes.

      - question: Are you getting the hang of this?
        type: choice
        options:
          - option: true
          - option: false

      - question: How old are you?
        type: text

      - question: What best describes your sleeping habits?
        type: choice
        options:
          - option: crap
          - option: neutral
          - option: good
```

```
- instruction: Hey it is a likert question. Imagine that.

- question: On a scale of one to seven, how awesome are you?
  type: likert
  minrange: 1
  maxrange: 7
  stepsize: 1
  mintext: very awesome
  maxtext: godlike
  required: true
```